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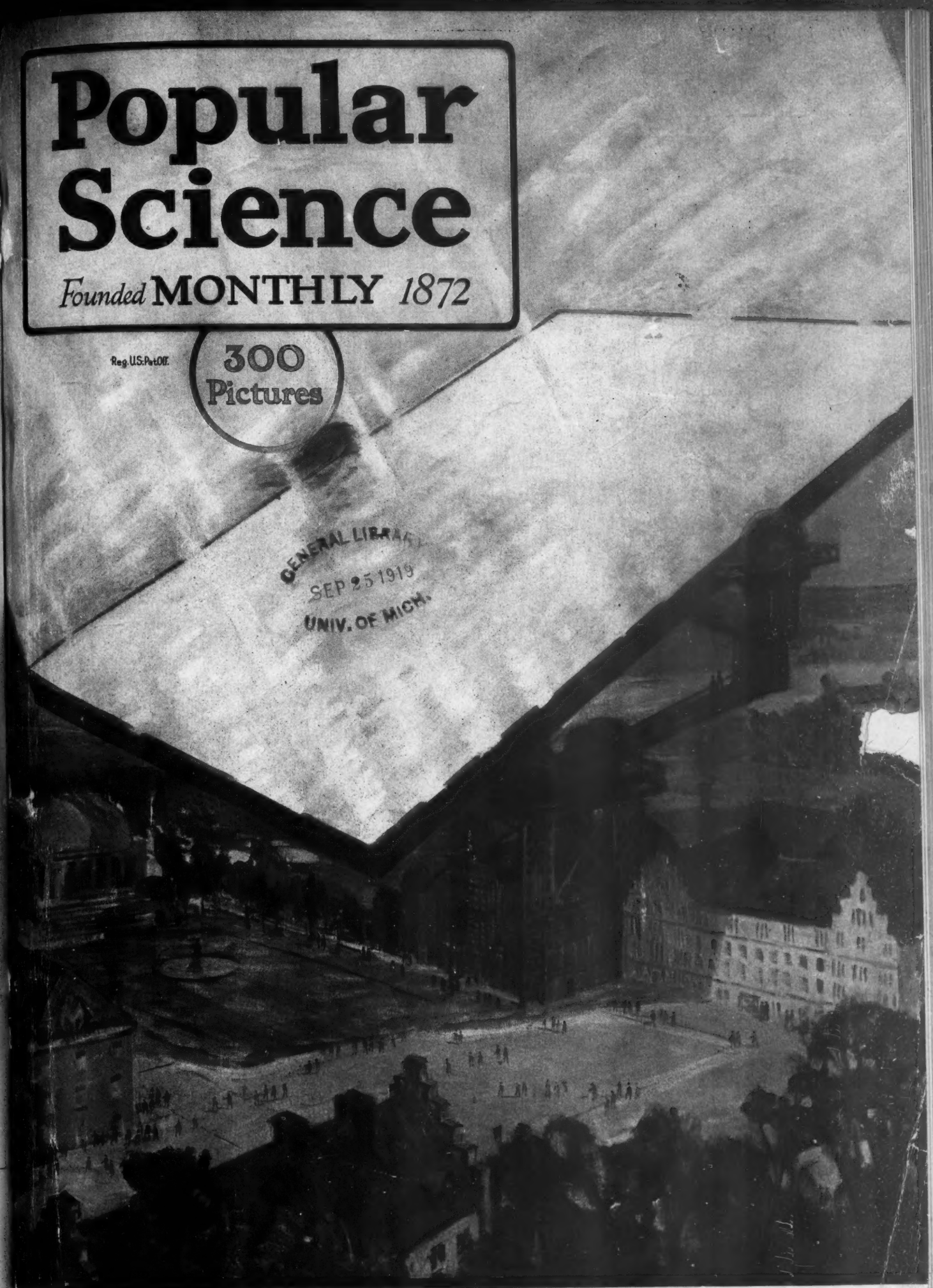

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Popular Science Monthly

Waldemar Kaempffert, *Editor*

September, 1919; Vol. 95, No. 3
Twenty Cents; Two Dollars a Year

Published in New York City at
225 West Thirty-ninth Street

Changing the Course of a River

A powerful dredge that sucks up the bottom of the sea

UNDERCURRENTS, the rise and fall of the tides, the flow of a river as it follows its course,—all battling together beneath the surface,—constantly disturb a river-bed. Its soil is picked up, swept away, and dropped where the waters see fit. Whereupon man comes along with his dredge, gathers up the soil, and puts it back again. But sometimes changes are desired, as, for instance, when the channel must be deepened.

When the Soil Is Soft

When the soil that is to be dug up is soft, a suction dredge is generally employed to do the work. A pipe is lowered until it touches bottom. Then a pump, which is attached to the upper end of the pipe, is started. The soft soil is sucked up and dumped into a well within the ship. Later it is carted away.

The dredge on this page is a suction dredge, but it is constructed to suck up hard, stiff clay—a very unusual combination. The pinwheel-shaped cutter at the bow of the ship makes this possible. The cutter is attached to a shaft that runs up through the suction-pipe. When the pipe is lowered into the water, the whirling cutter first plows up the clay, which the pipe then swallows.

Eight Revolutions a Minute

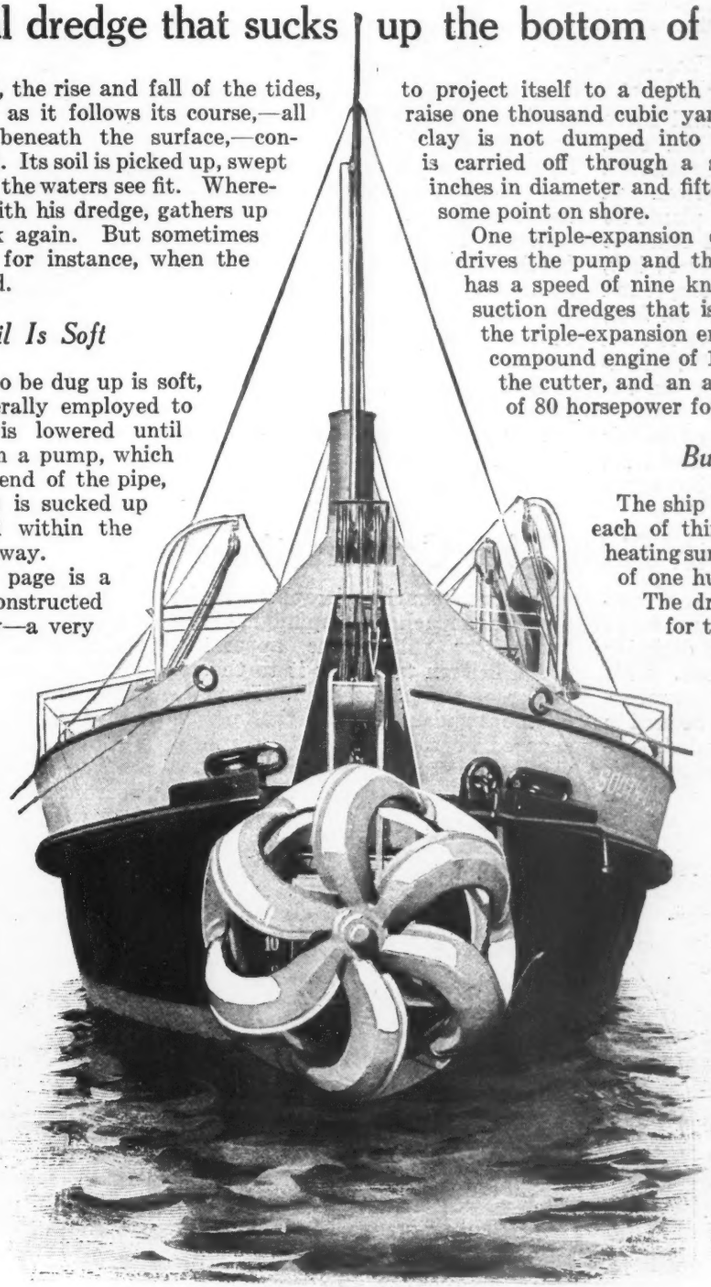
The cutter-head is composed of a set of hard cast-steel knives, and is turned at the rate of eight revolutions a minute by a 175-horsepower compound engine. It is possible for the pipe to project itself to a depth of forty-three feet, and to raise one thousand cubic yards of clay an hour. The clay is not dumped into a well in the ship, but is carried off through a second pipe, twenty-eight inches in diameter and fifteen hundred feet long, to some point on shore.

One triple-expansion engine of 725 horsepower drives the pump and the ship's propellers. She has a speed of nine knots, and is one of the few suction dredges that is self-propelling. Besides the triple-expansion engine, there is the auxiliary compound engine of 175 horsepower for turning the cutter, and an auxiliary compound engine of 80 horsepower for working the winches.

Built in Holland

The ship has two cylindrical boilers, each of thirteen hundred square feet heating surface and a working pressure of one hundred and eighty pounds. The dredge was built in Holland for the Australian government, and will be used on Australian rivers; it is called the *South Australian*. The length of the dredge is one hundred and thirty-seven feet, six inches; the breadth, twenty-nine feet, six inches; depth, eleven feet, six inches.

When the dredge was tested she exceeded all expectations. Instead of raising one thousand cubic yards of stiff clay in an hour, she raised eleven hundred and twenty-nine cubic yards. And when she was put to work where there was a sandy bottom she sucked up twenty-six hundred tons an hour.



The pinwheel-shaped cutter at the dredge's bow chops up the hard clay of the ocean bed, which the suction pipe then swallows with ease

By turning a fly-wheel a boy can move this greenhouse from plants that no longer need shelter to those that do

What—a Traveling Greenhouse?

LIKE a setting hen that will move from nest to nest when each batch of eggs is hatched, there is now a greenhouse that will move from bed to bed when each batch of plants no longer needs protection. Of course it doesn't move of its own accord; but, although it weighs twenty tons, it can be moved by a small boy. In fact, the same small boy can move it even when it is weighted down with an additional fifteen tons of men—as the illustration above shows.

The greenhouse is raised on wheels that run on tracks placed about six feet apart. To move it the boy turns a wheel. Inside the greenhouse are pipes and a boiler for heating it, a cold water supply, a ventilating gear, and every other greenhouse necessity.

When it has sheltered one batch of plants until they are sufficiently strong to battle with the elements, the hinged eaves of the greenhouse are lifted up and fastened in place until the moving to a younger bed is finished. Thus it passes easily over the taller plants.

This greenhouse measures one hundred feet, and it was invented by Mr. A. Pullen-Burry, of Worthing, England.

Recording Both Sides of a Conversation

IN cases where important conversations are carried on by business or professional men it is often desirable to preserve an authentic record. This has been made possible by the recent invention of an apparatus to be used in connection with an ordinary desk telephone and one of those phonographic recorders now extensively used for dictation. In the accompanying picture the apparatus is enclosed in the neat case with the curved receiving horn.

For direct dictation the person who is dictating speaks into the curved horn. The sound vibrations strike the telephone transmitter, which carries them to a highly sensitive magnetic recorder.

When a telephone conversation is to be recorded, the receiver of the telephone is placed on top of the case, as shown in the picture. The weight of the receiver actuates a lever which closes the inside opening of the curved horn and allows the sound vibrations from the microphone of the receiver to reach the diaphragm of the transmitter within the apparatus, which in turn transmits it to the recorder of the phonograph. In place of the regular receiver the person engaged in the conversation uses a watch-case receiver, which, when not in use, rests in a socket in the case.

With this instrument interposed between your telephone and your dictation-recording phonograph, you can easily record both sides of a telephone conversation

Salt Down Your Peas and Beans

DO you like sauerkraut? Then you will also like sour beans, peas, beet-tops, and many other vegetables. They may be kept in almost any kind of jug, jar, keg, or tub, for they need no air-tight lids.

The souring of the vegetables is due to fermentation brought about by the action of salt. Take string-beans, for instance. You lay a one-inch layer of beans on the bottom of a crock, then sprinkle it with salt. Put in another layer and sprinkle that with salt. Keep this up until your crock is three quarters full, using salt at the rate of three pounds to a hundred pounds of beans.

Salt will preserve vegetables; a small amount causes fermentation, while large quantities keep the vegetables fresh

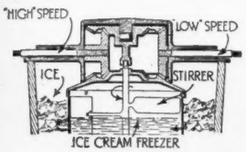
Cover the beans with cheesecloth; on top of the cheesecloth place a board and a stone to weight it down. The weight and the salt will extract the juice from the beans and form a brine in about twenty-four hours. Then the cheesecloth, board, and stone are removed, and fermentation begins. While it is going on bubbles rise to the surface. As soon as these bubbles cease, the fermentation is complete and the crock should be removed to a cool place. To prevent mold, cover the beans with paraffine or oil.

But suppose you don't like that sauerkraut taste. Then preserve your beans with a large amount of salt or a very strong brine, and they will keep their natural flavor.

Two Speeds for the Freezer

"WHAT are you running her in?" "High," comes the answer from behind the barn. You listen for the purr of a motor, but you don't hear any. Why? Because the men are running, not an automobile, but an ice-cream freezer. Wade H. Stemple, of West Virginia, has invented an ice-cream freezer that, like a Ford, has two speeds, high and low. As in the case of an automobile, high speed means that the shaft revolves rapidly while very little power is used, and low speed means slow rotation at greater power. It is operated very simply by means of two handles, one for each speed.

But why should an ice-cream freezer need two speeds? you ask. Compare its problems with those of an automobile. When freezing is started, the contents of the can are in liquid form and offer little resistance to the revolving blades. When the ice-cream thickens, more power is needed to turn the shaft.



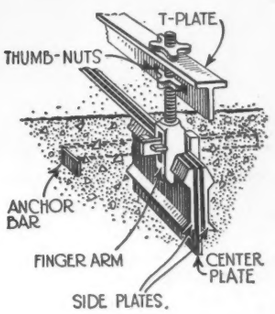
At high speed the shaft revolves rapidly, using little power, while low speed means slow rotation at greater power

This ice-cream freezer has two speeds, high and low, just as an automobile has; but the difference is, in the freezer both gears can be worked at once

Both of the gears may be used at the same time.

Taking Bumps Out of Roads

The T-bar by which the plate is lowered into place rests on forms in the road. The plate is attached by threaded nuts and moved up and down by thumb-nuts



Section view of the apparatus for lowering the plate

"DON'T take that road, it's full of holes," a fellow motorist tells you. Whereupon you ask yourself once again why a fairly new concrete road should have developed holes in so short a time.

Perhaps some of them are due to the breaking of the concrete at the expansion joints. These joints are necessary — as in the case of railroad tracks—to allow for expansion in hot weather and contraction in cold. They are usually made by inserting thin boards along the road before the concrete is applied, and then pulling the boards out again after the concrete has hardened. But the sharp concrete edges break easily.

To overcome this defect, a new armor-plated expansion joint has been invented. The plate is made up of three parts: a thin central one extending through to the bottom of the concrete, and two shorter, thicker ones attached to each side of the thin central one. All three are set flush with the top of the road. The outside plates have beveled edges to prevent chipping of the adjacent concrete. A strip is cut from each outside plate and bent back to provide anchor arms. The plate is lowered into place by means of a T-shaped bar.

Make Your Flashlight Batteries

THOSE who have watched the growth of the flashlight industry for the past ten years have noticed two things in particular: the rapid transforming of this article from a novelty into an every-day necessity; and a growing growl of discontent at some batteries on the part of the consumer as well as of the merchant.

Heretofore you have not been able to buy more than one battery at a time. For, by the time you were through using the first battery, the other one would have become almost exhausted.

Now you can buy a set of six or more cells, and make up your own batteries whenever you care to do so. You can send a set to a friend in France or distant China, and he can make his own batteries when the package arrives.

Full instructions accompany each battery set and it is easy to make any kind of battery by following them.

It is in the perversity of things that batteries generally give out when they are needed most. What a convenience it would be to be able to make one any time you needed it.

Here is the complete set. The battery can be made and assembled in the space of just a few minutes. A simple mixing of chemicals is the secret of this very useful idea

Making Freight-Trains Do More Work

Will the Bonner rail-wagon system solve the problem of freight-car congestion?

By Joseph Brinker

IT is contended that our railroads are today run on unsound economic principles. What are these unsound economic principles? you ask. Well, consider for a moment these few facts:

That, whereas the average speed of a freight-train is twelve miles an hour, or two hundred and eighty-eight miles in twenty-four hours, the average freight-car mileage per car per day is only 23.7 miles. In other words, out of every twenty-four hours the average freight-car is actually running only two hours.

That the average earning per freight-car per day is only three dollars and fourteen cents, notwithstanding that the charge of the average of freight hauls in the United States is seventy-five cents a ton for each hundred miles moved, with the capacity of the cars ranging from forty to sixty tons apiece.

That the total freight revenue for 1918 of $2,869,446,322 was earned with freight-cars actually in motion only two hours out of a possible twenty-four, or only one twelfth of their earning capacity.

The trouble seems to be that the railroads furnish not only transportation but also warehouse facilities. The cars have become warehouses to all intents and purposes, because they stand still for twenty-two out of every twenty-four hours. This warehouse service chokes the railroad terminals; ties up freight-cars; cripples the system; and, finally, is the cause of the financial difficulties with which the roads are now confronted.

The confusion that is apparent to any observer in the neighborhood of city terminals contributes to the present serious freight-car congestion; the "rail-wagons" of the Joseph Bonner type suggest a possible solution of the problem

From Producer to Warehouse

The Bonner rail-wagon system of transportation, described on this and the opposite page, is of particular interest, since its adoption on a large scale would greatly reduce the idle freight-car time under the present-day methods. In brief, the Bonner system, invented and developed by Colonel Joseph P. Bonner, of Toledo, Ohio, offers a plan whereby freight of less than a carload may be moved direct from the point of origin to the destination warehouse or wholesaler without rehandling!

This seems impossible; but it has been accomplished by the joint use of road vehicles and rail vehicles. The basic unit is a road van in which the freight will be loaded at the point of origin. This van closely resembles a large furniture van, but differs from it in that it has its four wheels supported on side brackets instead of crosswise axles, so that the entire van, wheels and all, can be slid bodily on to a steam or electric railway-car chassis. Both the vans and the rail chassis cars are so designed that the mounting and dismounting of the units may be accomplished entirely by mechanical means and in a minimum period of time.

The van units or wagons are placed astride of the railway chassis car instead of on top of it, as is the usual method employed when moving circuses from town to town. By reason of the special mounting of the van wheels on brackets instead of conventional crosswise axles, the wheels of the units overhang the sides of the railway car. The elevating and lowering of the van units is controlled entirely by the steam or electric railway train engineer through the use of air-jacks on the rail units and employing the same air used for the air-brakes.

Aside from the road van, there are two types of railway cars, one for steam railways and one for electric trolley lines. Each is capable of carrying two or four of the road-van units. Each of the van units is provided with outside doors at each end on both sides, so that when two or more units are mounted on a railway car, the doors may be swung outward to form an end-to-end vestibule, giving the appearance of a continuous car body.

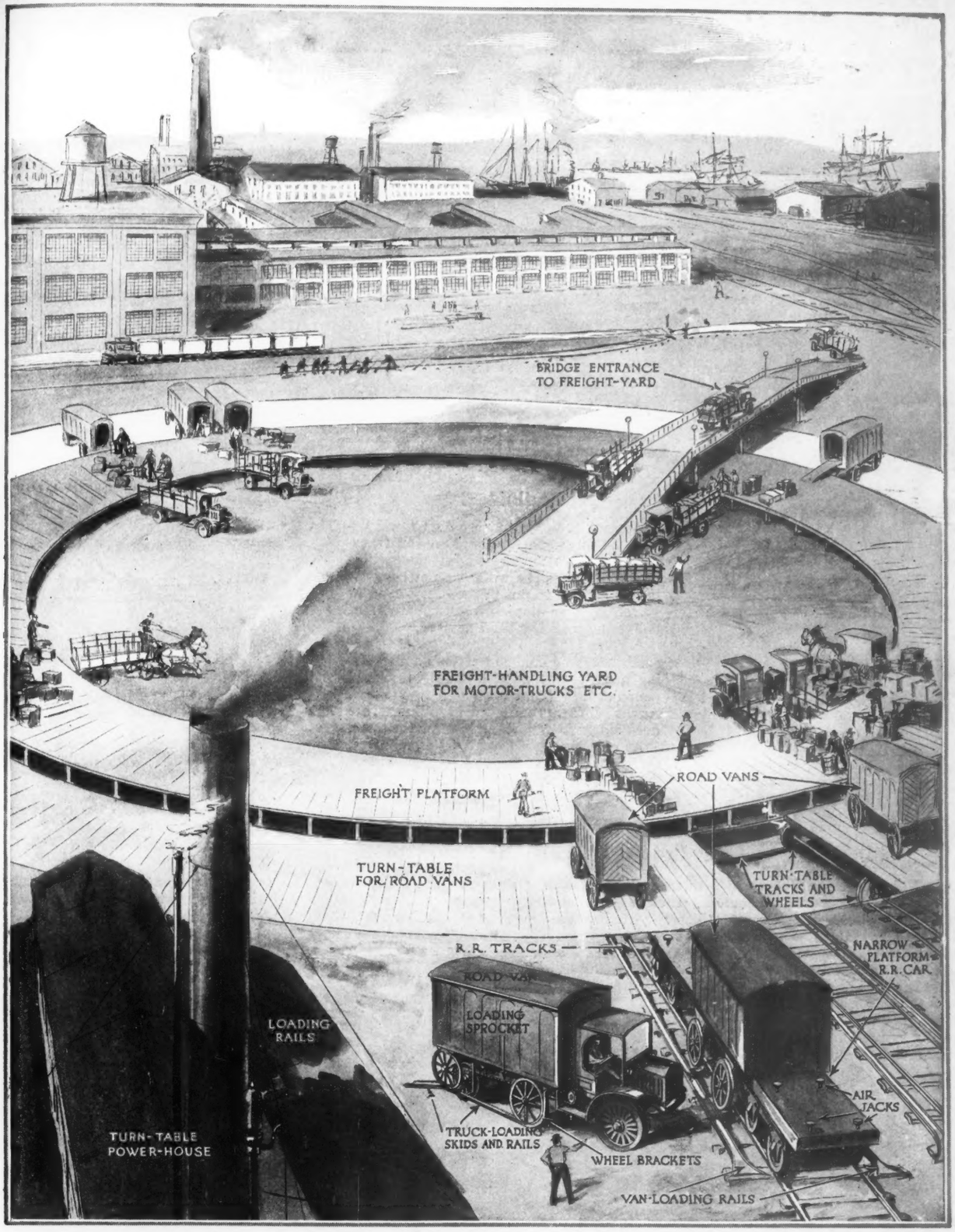
Specially Designed Motor-Truck

The fourth unit is a specially designed motor-truck provided with a low platform, upon which the entire van unit may be loaded by means of a sprocket-chain system operated by the truck's own propelling engine. Similarly, the van unit may be unloaded by the truck engine's power.

With the physical equipment of the system thus outlined, let us assume a shipment of wheat originating at a farm ten miles from the nearest electric railway. The farmer puts in a request for one or more empty van units. These are delivered to him by the electric railway company through the medium of the motor-truck unit of the system.

The farmer loads and locks each van unit, and notifies the electric railway company that they are ready for movement. The farmer can either drive them over the road to the railway tracks by teams of horses or preferably have them hauled on the special motor-trucks. Arriving at the electric railway tracks, the van units are pulled over and on to the special electric railway car chassis without disturbing the load. The electric railway then transports the loaded van units to the nearest steam railroad if the wheat is being shipped to a distant point. Here they are again transferred, this time to the steam railway car chassis. The van units are then hauled over the rails to the railway terminal, where the vans may be removed and unloaded or loaded on an electric car line, and finally on to the motor-truck for final delivery.

The plan has great possibilities for eliminating the present terminal congestion. It is proposed to construct a terminal in the form of a great circular platform with an open space in the center for street vehicles, and a revolving turntable on the outer circumference on which the loaded or empty van units could be switched to the platform from the terminal yard tracks.



Circular Platform to Be Used in the Proposed Bonner Rail-Wagon System

The platform shown above, which it is proposed to construct at railroad terminals for use in the Bonner rail-wagon system, would be approximately one hundred and fifty feet in diameter. A large open space in the center, reached by means of a bridge, would accommodate street vehicles, and a revolving turntable on the outer circumference would switch the van units of Mr. Bonner's scheme from track to platform. Fifty wagons or motor-trucks at a time could back up to this platform and deposit their contents. Then, by revolving the turntable, the van units, backed up to the outer edge of the platform, could be brought to any outgoing freight deposited on the platform. The circular platform could easily be adapted to use as a market-place

He's Making Sure to Give Full Measure

THE smile on this orchardist's face might be called the "full-measure smile."

The contraption connected with the handle is a press that is used to put all the apples possible into a barrel without making cider of them. The barrel is filled to overflowing, is placed on the bent lower ends of the iron side pieces, and pressure is applied until the head boards are in place.

Carelessly packed apples are apt to bruise in shipping.

©Keystone Photo News

Stand By to Pick Up the Mail Keg!

IT is not unlikely that the Azores will become an important station for transatlantic air commerce; yet steamships hurrying across the water do not consider it worth while to put in there, not even at Fayal, and so a picturesque method of delivering mail has been devised.

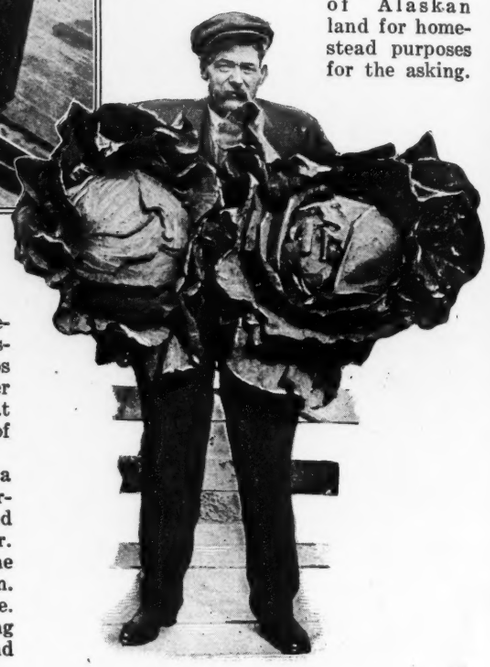
Letters for the islands are placed in a small keg, weighted so that one end, bearing a staff tipped with a bright-colored pennant, will stand upright in the water. As the ship nears one of the island ports, the deck officer sounds a long blast on the siren.

At once small boats put off from shore. Overboard goes the mail keg, riding shoreward on the swell from the ship, and is picked up by the boatmen.

This Is How They Grow in Alaska

SHOULD you meet the Walrus in Alaska, and should he start his favorite conversational topic, "Cabbages and kings," you can come right back at him with the remark: "I know little or nothing of kings; but, speaking of cabbages, did you know that H. O. Banta, just south of Skagway, raised two cabbages that weighed thirty pounds each?"

Any United States citizen can have 160 acres of Alaskan land for homestead purposes for the asking.



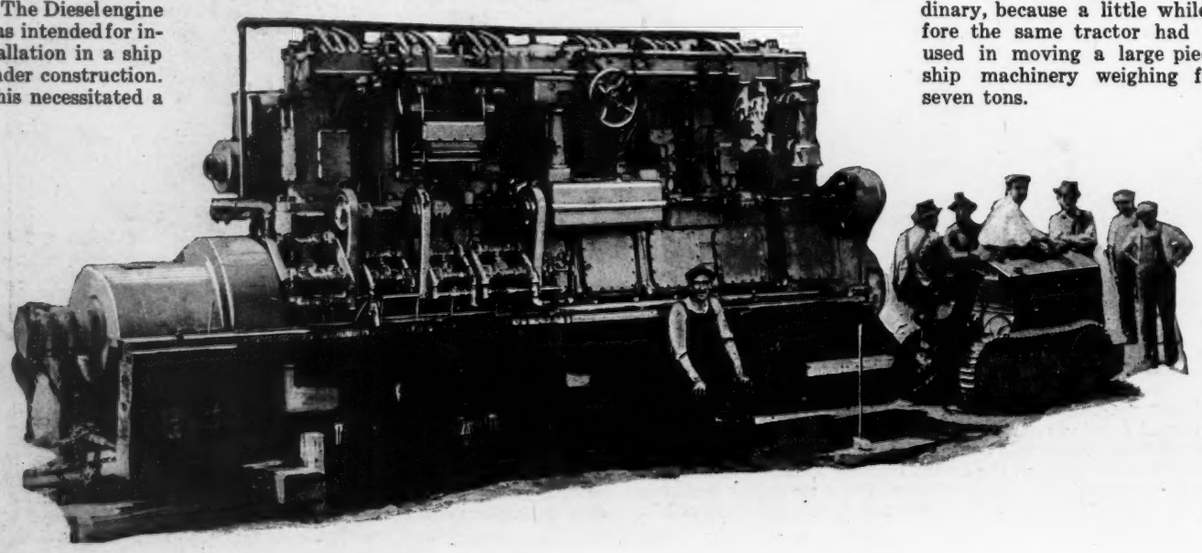
This Tractor Rivals the Feats of Samson of Old

WHEN Samson staggered off with the gates of Gaza on his shoulders, the multitude gasped. When a small caterpillar tractor hauled a twenty-seven-ton Diesel engine an eighth of a mile, it was considered a part of the day's work.

The Diesel engine was intended for installation in a ship under construction. This necessitated a haul from the freight-yards to the plant of a shipbuilding company at Newburgh, N. Y. The length of the haul was a little more than an eighth of a mile, and the engine was handled on greased skids with the aid of triple blocks.

Its trip was not marred by a single accident, the tractor loafing along ahead of its heavy burden with the tranquillity of a turtle making its way toward a sun-kissed spot on a sandbar.

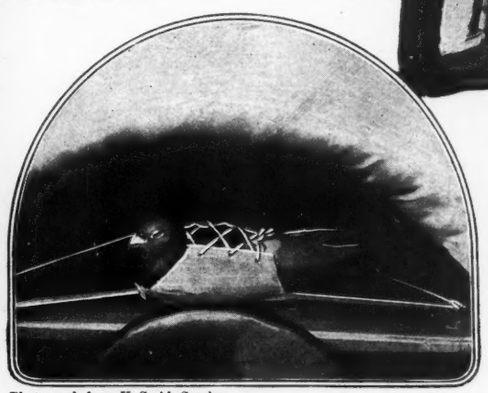
The feat was not considered extraordinary, because a little while before the same tractor had been used in moving a large piece of ship machinery weighing forty-seven tons.



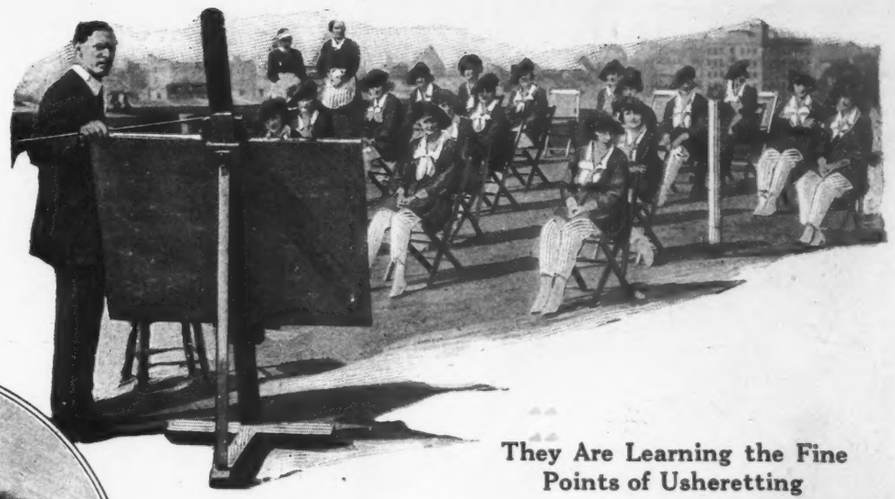
He'll Soon Be Out of a Job

TRUSSED up in a vestlike jacket and stowed away comfortably enough on a little shelf just behind the pilot's seat in the airplane, this homing pigeon was the aviator's only means of sending word back to head quarters. On many occasions the pigeons carried appeals for help from men whose airplanes had fallen in the sea.

The perfecting of wireless, both telegraphic and telephonic, promises soon to end the romance of the pigeon post.



Photograph from U. S. Air Service



They Are Learning the Fine Points of Usheretting

"FIRST aisle to the right," says the pleasant-mannered usherette. Next moment you are following in the wake of another soft-spoken young woman, who guides you to your appointed place, says "Third and fourth in," slips the programs into your hand, and leaves you feeling that if the chorus measures up to the usherettes the tired business man is due for a restful evening.

So important is this first impression considered by a Los Angeles manager that he has established a school for usherettes. It is on the roof of his theater. The class meets daily to hear and discuss lectures on efficiency, dress, tidiness, and the fine art of courtesy. New costumes are provided from time to time; and this is said not only to please patrons, but to be helpful in keeping up the morale of the usherettes.

Mr. Wong at an Exciting Baseball Match

LEE WONG — who, so far as we know, is the only Chinese baseball reporter in this country, takes his baseball through a telescope.

Mr. Wong used to cover baseball for a paper in Hongkong, where the Yankee game long ago became a formidable rival of native sports. Now he is writing diamond gossip for a San Francisco newspaper. He swings his somewhat unwieldy glass with unerring precision and no fast infield play escapes his eye. He is said to be a wonder in dissecting close plays at the bases.

This House Was Blasted Out of Rock

A MINER of Cold Creek Canyon, Cal., looking for something novel in the line of houses, blasted a house for himself out of a huge boulder in the mountains.

He seems to have improved upon the Scripture injunction to build one's house upon a rock, for his whole house is a rock.

This unique house has two windows, a door, and a sheet-iron roof. It bears out the Biblical story; for last summer, says its occupant, when a fire swept through the canyon, all he had to do was to go into his boulder house and remain there in perfect safety until the fire, sweeping around his house, burned itself out.

It Beats a Hand-Car for Adventure

IN Alaska the motor-sled threatens to replace the dog in the transportation systems of the far north, at least over important mail routes. But, if the dogs go, they will retire with honors. They had their try-out on the battlefields of the great war, and made good. Instead of pulling sleds over snow-fields, they hauled small cars along narrow-gage railroads to carry food and ammunition to the front.

Their ability to do heavy work on little food made them in some places more efficient than the fuel-eating motor. They were also easily trained to silence, and on their battlefield job silence was at times more than golden. Rear-Admiral Peary says motor-sleds will never compete successfully with dogs for polar work.

Give Me My Pound of Flour

THE scale shown below is different from any scale invented heretofore. The indicator is not of the gravity-controlled pendulum type. And what difference does that make? When the indicator of a dial scale is controlled by gravity it will always remain in an upright position when no weight is applied. Therefore the zero point of the dial is always located directly above it. That the two may coincide, the scale must be kept in an absolutely horizontal position.

In this new scale the indicator is controlled by a vibrating arrangement inside the scale itself, which is independent of gravity. Thus, if the scale is tipped, the indicator tips too, without changing the weight. For actual weighing the balance system is used.

The indicator of this scale is not controlled by gravity and so correct weight may be obtained even if the scale is tipped

If anyone gets locked in a vault, an alarm bell over the fire marshal's desk will soon ring, while an indicator on a board tells which vault holds the prisoner

The person locked in need only break a bit of glass in order to give the alarm

Locked In? Break the Glass

WE all have heard gruesome tales about persons accidentally locked in vaults—how they slowly suffocated while they used up their last ounce of energy in madly shouting and beating on the thick doors through which no sound could pass.

Not long ago, after such an episode, one of the employees of a corporation in Philadelphia suggested the adoption of a simple electric device which has resulted in doing away with the possibility of a recurrence of such an experience.

Now, if anyone gets locked in a vault, all he has to do is to seize a small hammer, hanging by a chain beside a little round frame which holds, under glass, a paper bearing this concise inscription: "If locked in, break this glass."

The moment the glass is shattered a loud gong in the fire marshal's office sets up an alarm; and when he hears the gong the man on duty looks at an indicator that points to the number of the vault. He immediately sees that the doors are opened.

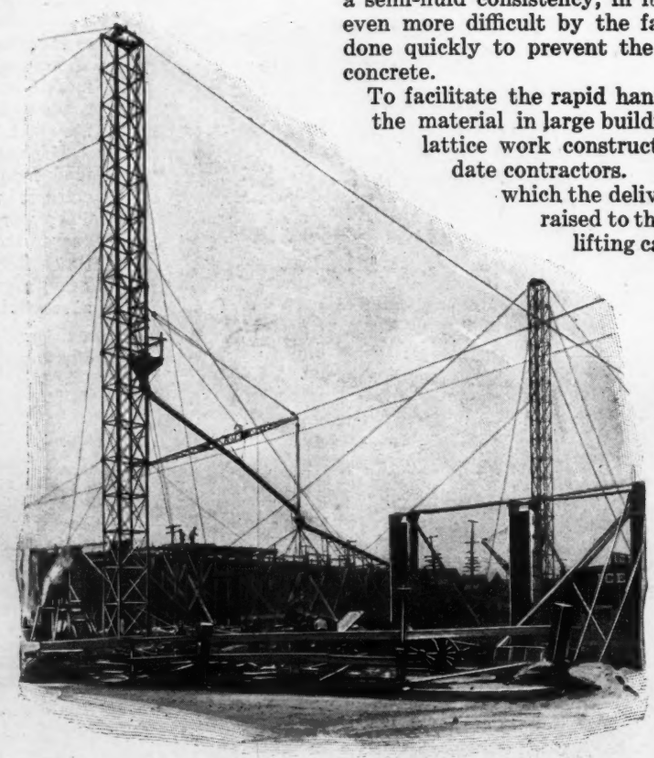
Feeding the Concrete Chute

IN the construction of many modern buildings for manufacturing or other purposes, enormous quantities of concrete are used. The handling of so much material of a semi-fluid consistency, in itself a difficult task, is made even more difficult by the fact that the work must be done quickly to prevent the premature "setting" of the concrete.

To facilitate the rapid handling and the distribution of the material in large building operations, steel towers of lattice work construction are employed by up-to-date contractors. A hopper, to the lower end of which the delivery chute is attached, can be raised to the desired height by means of a lifting cable. The hopper is supported by a frame which slides in a groove between the vertical supports of the tower.

The concrete is hoisted and dumped into the hopper by means of a dumping-bucket which can be raised or lowered within the framework of the hoisting-tower like an elevator.

One man can control the hoisting and pouring of the concrete. When the dumping-bucket reaches the hopper, rollers engage in the projecting ends of a curved switch extending beyond the top frame of the hopper. As the rollers follow the curve of the switch, the bucket is tilted and its contents emptied.



After the hopper, to which the chute is attached, has been hoisted to the required height, the buckets, filled with concrete, are sent up

Turn the Crank and Out Comes Character

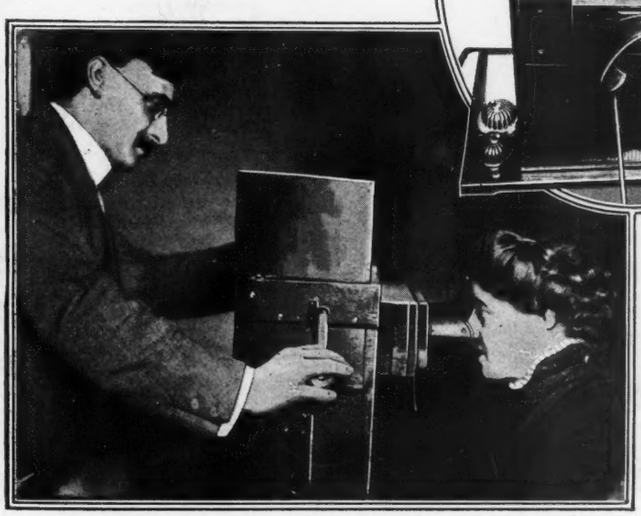
DO you believe that we inherit our very natures, dispositions, characters from our ancestors? That they made us what we are today? Very likely you don't. But Mr. J. Gray, an English psychologist, believes it, and he has invented a machine to prove his theory. According to Mr. Gray, "perseveration" is inherited; and "perseveration" decides character.

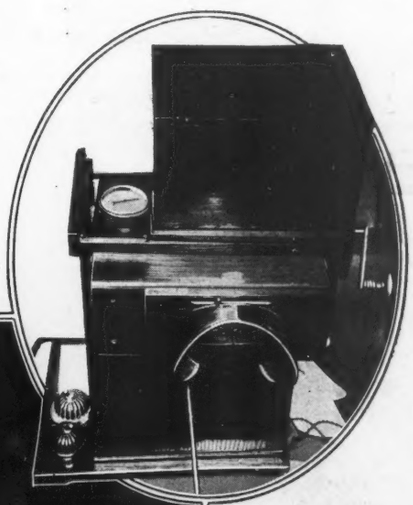
But what is "perseveration"? It is the name that psychologists give to the property of the brain that causes a sensation—a noise, for instance—to linger in the consciousness after it has really stopped. Mr. Gray's machine measures perseveration, not by sound persistence, but by color persistence.

You look through glasses into the machine while the examiner turns a crank that revolves a mirror inside. The mirror reflects two lights, usually one red and one blue, mounted in the top and bottom of the machine. The speed of rotation is increased until the two colors fuse into one. You indicate when this seems to take place. The difference between the real fusion moment and the apparent one indicates your "perseveration."

If these two moments coincide you are said to have "average perseveration," and, according to Mr. Gray's scale, you are consequently a practical, common-sense person. If the apparent fusion occurs before the real fusion you have "low perseveration." You are then a brilliant, suggestive, tactful, daring soul—provided your perseveration is not too low. Lower classes include cynics, punsters, and, lastly, maniacs.

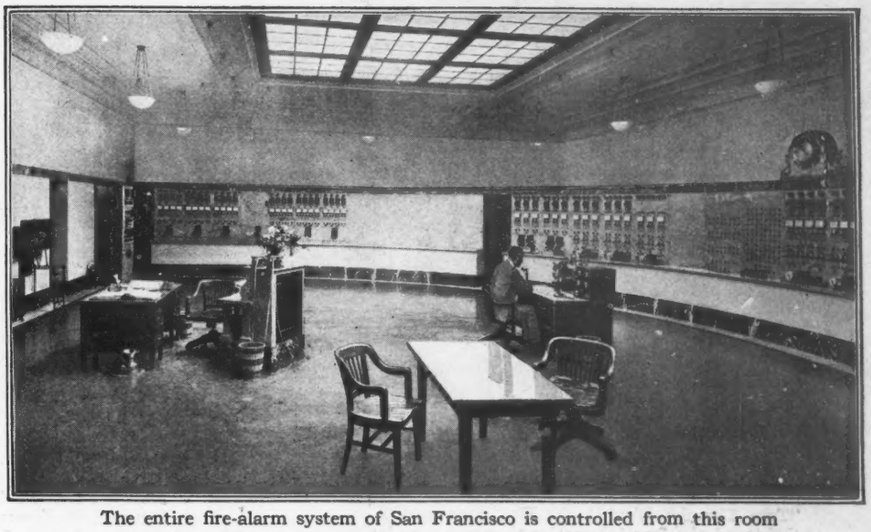
High perseveration characterizes scientists and writers and all other abstract thinkers. Extremely high perseveration denotes melancholia.





A revolving mirror reflects two different-colored lights in the box. You indicate when fusion takes place, thus showing your "perseveration"

She is having her "perseveration" measured, in order to discover her inherited disposition



The entire fire-alarm system of San Francisco is controlled from this room

No More Terrible Fires for San Francisco

OF course you remember the great San Francisco fire? Well, it is probably the last great San Francisco fire that you will remember, for the city has safeguarded itself by installing a central fire-alarm station which controls all the call-boxes and fire-houses throughout the city. Moreover, it is fire-proof, earthquake-proof, mob-proof, and burglar-proof.

Above is shown one half of the main semicircular switchboard. It is one hundred and two feet long. The operator sits at the center of the circle, and keeps an eye on all the boards. Just under the clock and extending on outside the picture, are the switchboards that receive the alarms sent in.

These alarms are so arranged that they will ring four times. The operator then goes to the far end of the room, where six panels are located, and sends out the orders to the fire-houses. Between these two sets of switchboards are five panels, called the hospital set. These are not, as might be expected, connected with hospitals in the city, but are themselves "hospitals," serving in case lines are broken.

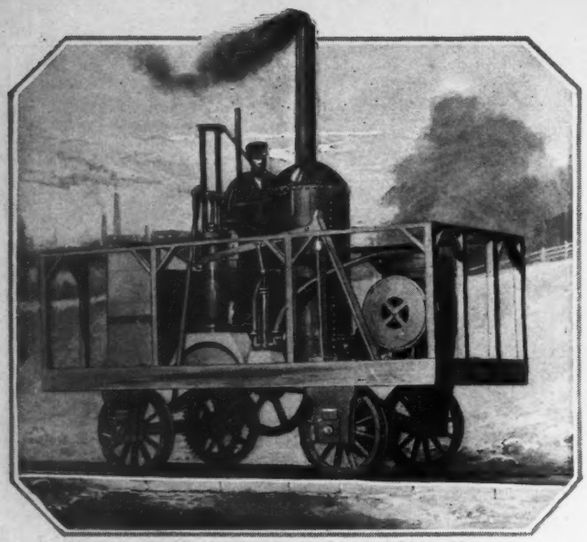
When a chief reaches a fire, he calls the central office by telegraph from the alarm-box and asks for anything he needs—additional engines, chemical wagons, high-pressure service. An operator sends out the orders.

Furthermore, an alarm bell is stationed at all places where there is heavy traffic for warning people and vehicles to clear the road for approaching engines.

The Danger of Empty Gasoline-Tanks

EMPTY gasoline-tanks are always more dangerous than full ones. In most cases some residue remains in the tank or can. The remaining gasoline vaporizes and is explosive. As the tank is being filled this mixture is forced out and will explode if ignited by a spark held near the opening.

To guard against accidents, all openings should be blown out with compressed air. If this method cannot be used the cover should be removed and the vapors fanned out. Unless a current of air is circulating, gasoline should never be used for cleaning engines or other machinery; and if air is passing, lights should be kept at a safe distance on the intake side of the engine.



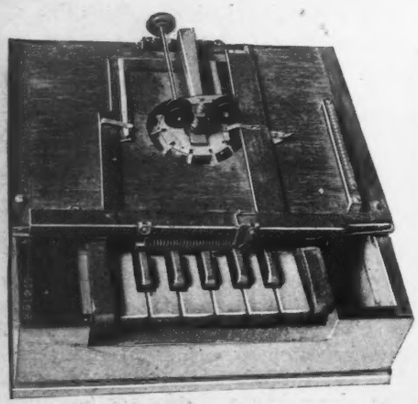
"Tom Thumb" is what the Baltimore and Ohio christened the first locomotive that was ever built in America. Don't sniff too much at this engine. It was a marvel in its day, which was in the thirties

It's strange how the old horse-drawn coach dominated the early railways. Look at this picture of the first American railway train, which made its trip over the Mohawk and Hudson (the line between Albany and Schenectady, from which the New York Central system grew) on July 31, 1832. The poor guards had to sit on

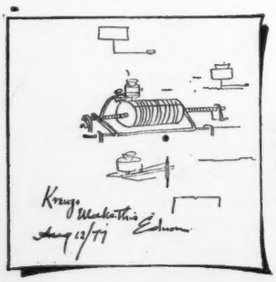
Big Oaks from

If you are an inventor don't be

show how some of the men who

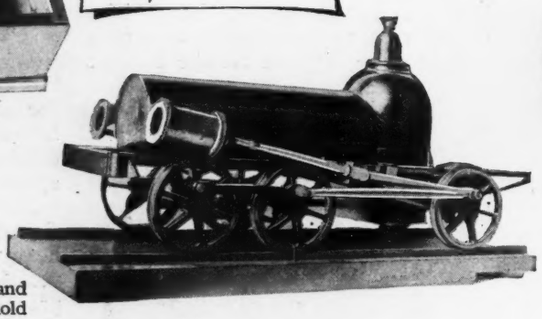


The pioneer inventors of typewriters never thought of writing business letters by machine. They merely wanted to help the blind! This is the invention of Sholes, Glidden and Soule

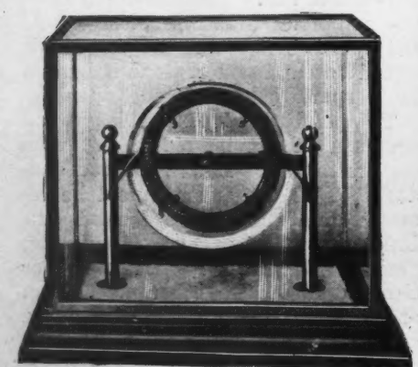


See this little sketch? It was Edison's first suggestion of the phonograph

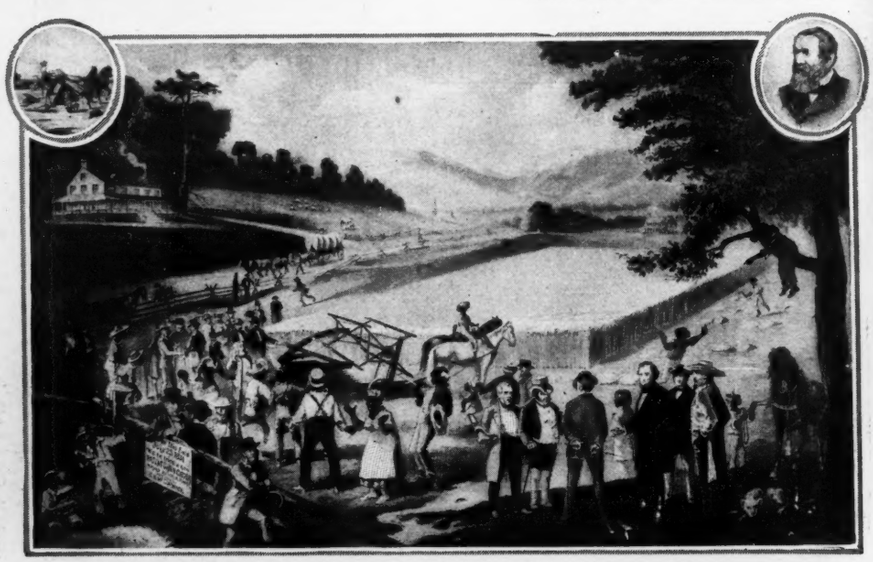
When next you pick up the telephone to say that you are not coming home for dinner, remember these first crude instruments of



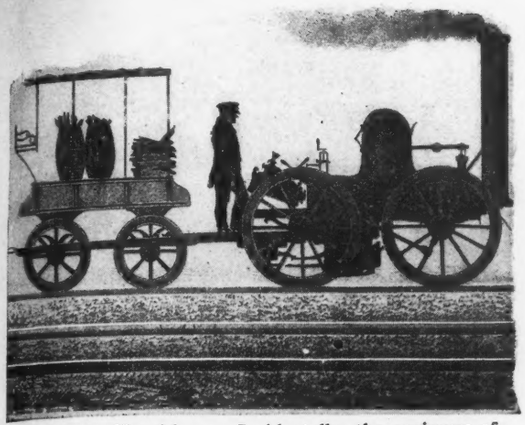
Cast your eye to the right and upward and you will behold a picture of the model of a locomotive that Matthias W. Baldwin, of Philadelphia, filed with the patent office 'way back in 1842. He explained how he proposed to convert the wheels into driving wheels by means of coupling rods. His idea has become the standard practice



Here is the first telegraph wire that ever carried a message. "What hath God wrought!" were the words that expressed America's wonder in 1835



Farmers came for miles around to see Cyrus H. McCormick turn his reaper loose in 1831. This is a reproduction of a contemporary engraving of that historic event. One know-it-all slapped his knee and said: "That invention is worth a hundred thousand dollars!" Too bad he couldn't have lived to see how the industry grew



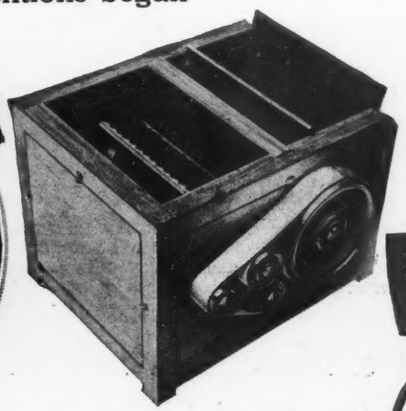
box-seats, like drivers. Incidentally, the engineers of that day were as sensitive as prima donnas. The first American-built locomotive, the "Best Friend" of Charleston, built in 1830, blew up after a few months because its attendant lashed down the safety-valve. He was annoyed by the sound of escaping steam

When the inventors got over the idea that typewriters were to be made only for the blind, they began to meet the business man's needs, and the first Remington was produced. Notice the lid, that could be swung down over the keyboard and locked. As for the typists of the early days—well, we like them if this is a specimen

Little Acorns Grow

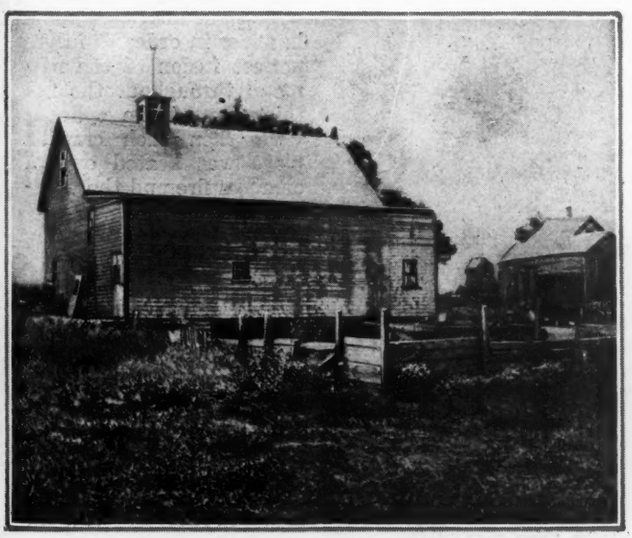
too modest. These illustrations conceived the big inventions began

Alexander Graham Bell's over which the first message was sent on March 10, 1876. It was telephoned from the attic to the second floor below



It is the outsider that revolutionizes industries. Eli Whitney was a modest school-teacher when he invented the cotton-gin

You still see some hand presses similar to this of Gutenberg's of 1450 on the right. Gutenberg's name is identified with the invention of movable type rather than with presses



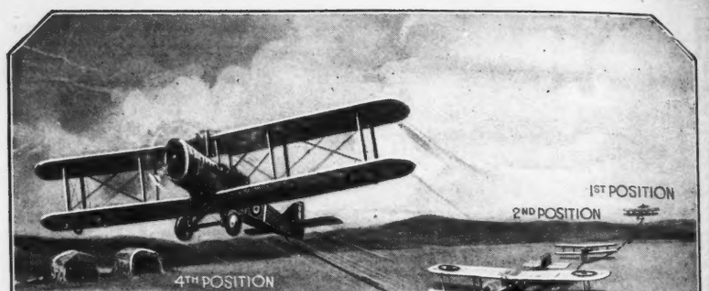
This is where the enormous packing industry was born. Here it was that Gustavus Swift, the founder of the business now known as Swift & Company, slaughtered the eighteen-dollar heifer that started him in business

Selden was a patent lawyer in Rochester when in 1877 he filed an application for a patent on what is the modern automobile. Over $2,000,000 royalties were paid by about eighty automobile manufacturers

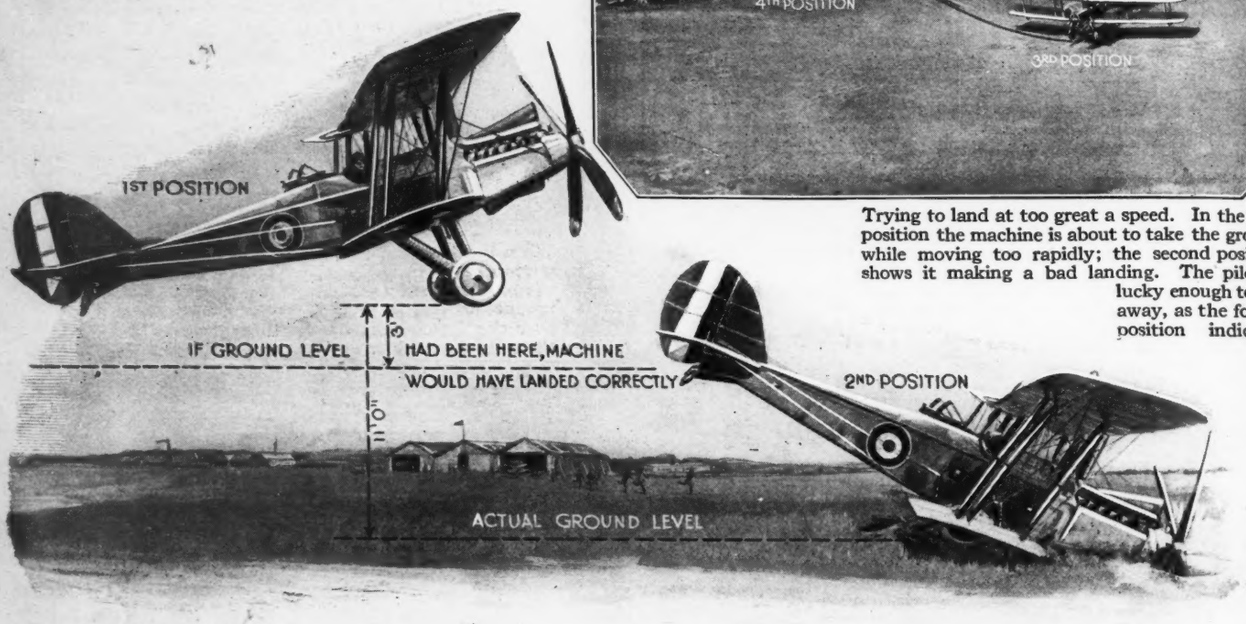
And this is Henry Ford in the first universal car. Ford had thrown up a job as a steam engineer in Detroit to produce this. He fought the Selden patent and beat it

Getting Down to Earth Again Is Not So Easy

Drawings by courtesy Division of Military Aeronautics. U. S. A.



Trying to land at too great a speed. In the first position the machine is about to take the ground while moving too rapidly; the second position shows it making a bad landing. The pilot is lucky enough to get away, as the fourth position indicates



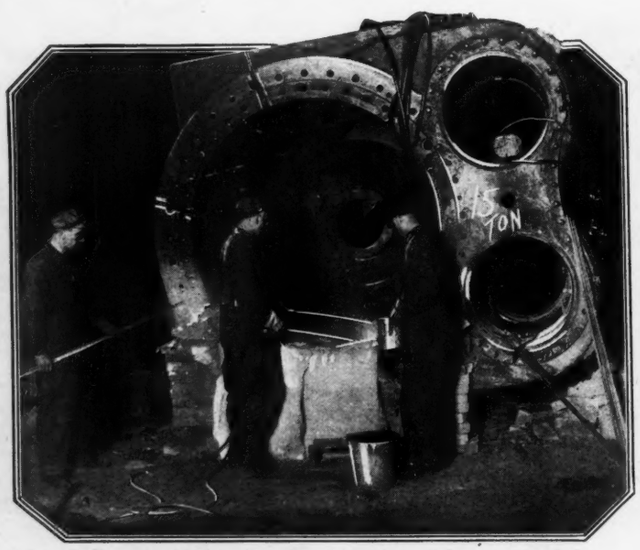
"Pancaking" means stalling the airplane just above the surface of the ground and dropping the remaining two or three feet with as little forward speed as possible. Such landings are made when the ground is rough, or over water or standing crops. The illustration shows how not to do it. In the first position the machine is seen to have flattened out too soon, with the result that in the second position the machine has crashed. This is called landing "above the ground"

Oxyacetylene Mends a Mammoth Engine Cylinder

THAT magic wand of modern industry, the oxy-acetylene blowpipe, added another triumph to its remarkable record of achievement, recently, when it made a wrecked engine cylinder of mammoth proportions whole again.

The cylinder was on a big rolling-mill engine, and a connecting-rod had broken. To appreciate the seriousness of the accident we must realize that three hundred and sixty men were employed in connection with the hundreds of tons of steel produced daily by this single rolling-mill. This meant that the small army of workmen would have been laid off for three or four months had not welding been tried.

The broken cylinder was a man-sized iron casting. To be exact, it had an inside diameter of five feet ten inches, an inside length nearly as great, and walls from two and one quarter to three and three eighths inches in thickness. The piston had crashed into the head of the engine, stripping the bolts and cracking the cylinder much as a knife cracks an egg-shell. There were seven cracks in all, varying in length from one to eight feet. The seven cracks were opened up by V-grooving with a pneumatic chipping hammer in order to insure perfect fusion of the new metal throughout the full thickness of the cylinder wall; then each cracked place was heated over a charcoal fire and the welding proceeded with.



By means of an oxyacetylene blowpipe, these men welded the cracks in a great cylinder—part of a steel rolling-mill

The charcoal preheating was done for economy's sake, charcoal being cheaper than acetylene, and for the further reason that in a casting of this size internal strains in the metal are avoided by heating metal adjacent to the weld and cooling it slowly. Asbestos paper was thrown over the charcoal fire. The mending operation required just seventy-two hours.

Is Your Child Growing Taller, Wider, and Thicker?

The mensurgraph makes exact records for purposes of comparison

By P. Schwarzbach

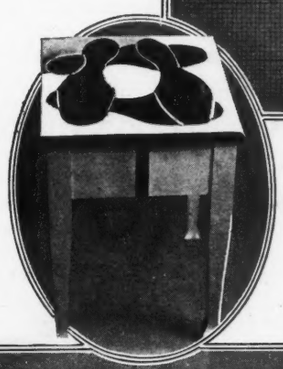
"HE'S grown an inch!" gloated your proud father when he backed you up to the kitchen door and made a periodic pencil mark on it. Yes, you had gained in height; but what about width and thickness? Had they increased proportionately? The pencil mark would not tell, and your father may have gloated too soon, for only proportionate growth is a sign of good health.

Exact width and thickness throughout the body had always been very hard to measure until Dr. Theron Kilmer, of New York, developed the "mensurgraph." The principle of this is simply to superimpose the negative of a screen on the negative of the picture of a child. Screen and picture are printed together, which makes them both clear. Future pictures of the child will be taken with the same camera at the same distance and with the same screening. Thus they will be similar and easily compared.

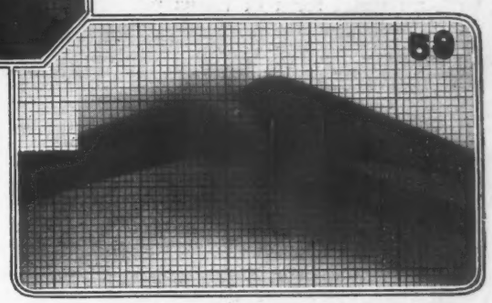
When Dr. Kilmer takes the original photograph of a person, he stands him on a white stool that has black footprints painted on it. The footprints face both front and sideways. If the front view is taken first, the person stands on the footprints facing front. The stool is located at a fixed distance from the camera. A black T is painted on the front of the stool which corresponds to a similar T on the ground-glass of the camera. Dr. Kilmer adjusts his camera until the two T's coincide—just as a surveyor adjusts his transit. Then he takes the picture in the powerful light of a mercury-vapor lamp.

After he develops the negative, Dr. Kilmer places over it, in printing, another negative, which is opaque except for a fine-lined screening and a guiding black T. The finished print then shows up child and screen. The screen is marked off in one-inch squares for convenient measuring. It looks just like graph paper used for plotting curves from reference axes; in fact, it is used as graph paper, only in this case the curve—of the body—is already plotted. By means of these many reference lines it is very easy to compare pictures as they are taken from time to time.

If the negative of a screen is superimposed on the negative of the picture the finished print will show both



The white stool on which the person being photographed stands has black footprints



X-ray pictures of a diseased joint taken at various times are easily compared

Dr. Kilmer is using the same camera, the same lens, placed at the same distance from the soldier being photographed, that he used when he took the soldier's picture six months before

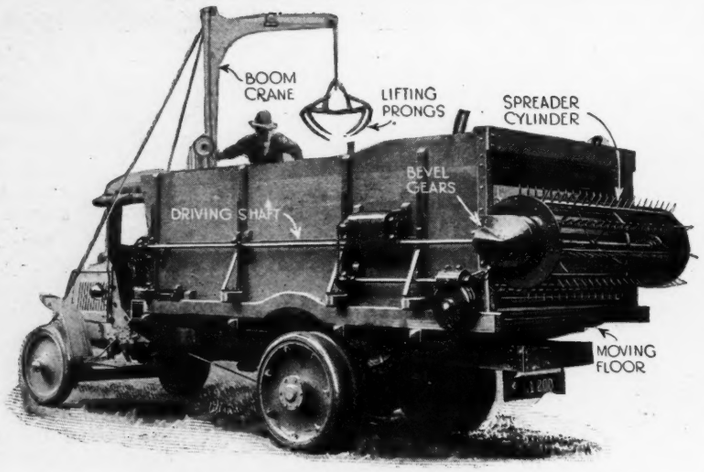
Dr. Kilmer uses a lens of 9½-inch focal length. He places the camera ten feet four inches in front of the stool and forty-nine and one half inches above the ground. Then a child who is four feet five inches tall will be reduced to four and five twelfths inches on the print. This reduction of feet to the same number of inches will always hold true.

The growth and development of the body are best illustrated by the measurements of height, the circumference of the head, shoulders, chest, and abdomen. In keeping a general record of a person's development, Dr. Kilmer reduces all these measurements to inches and then adds them together. He calls the result the number of "development units."

But the mensurgraph is not only used for recording natural growth of the body: it is used for recording the progress of deformities. The illustration that appears above shows an X-ray picture of a diseased joint. Thus growths, skin lesions, and stiff joints may all be closely watched.

This Motor-Truck Loads, Hauls, and Spreads the Fertilizer

ONE of the newest pieces of apparatus evolved for the labor-saving farmer is a motor-truck that does three separate tasks, and does each of them well. The first is to load manure into the truck body by means of a boom type of hoist mounted directly aft of the driver's seat and in front of the front end of the body, and driven by the power of the engine that propels the truck. The second is to haul the manure to the field on which it is to be spread. The third is to spread it evenly over the ground.



The truck loads the manure with a boom hoist operated by the engine, and its spreading apparatus distributes it over the field

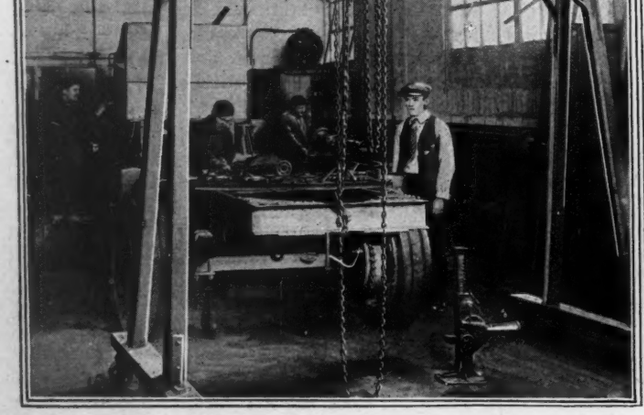
The manner in which the first and third of these tasks are accomplished is shown clearly in the accompanying illustration, the second or haulage task being the truck's regular work. It may be seen that the hoist is fitted with a special form of tongs pick-up device with which the fertilizer is pulled out of the pile on the ground, swung in over the truck body by the boom of the crane and finally deposited into the body. The body is also fitted with a moving slatlike false bottom which is driven off the same shaft that revolves the pronged cylinder, and simultaneously with it. This false bottom is like an endless platform, and pushes the manure in the truck body to the rear end, from which it is spread evenly by the cylinder like apparatus shown in the picture.

The cylinder is provided with spiked strips running longitudinally, and is revolved by a series of gears and shafts which receive their power from the regular truck engine at a power take-off on the gear-set housing.

When the driver throws in the cylinder clutch, the fertilizer is automatically fed to the cylinder, where the prongs pick it up and force it out in a thin layer of even thickness determined by the relative position of the prongs above the floor of the truck.

He Made His Own Truck Crane

A MOTOR-TRUCK owner in Brooklyn, N. Y., who owns a small repair shop, accomplishes the same results as those of a costly overhead traveling crane by means of the home-made hoisting device illustrated below. It is simply a large-sized horse mounted on rollers. It is moved over the truck chassis, the feet of the horse straddling the chassis frame on each side. A block and tackle or differential block is suspended from the center of the top cross-arm and easily lifts out any truck part. When the part has thus been removed, it may be transferred to any other location in the garage by moving the horse to the desired point, when the part may be deposited.

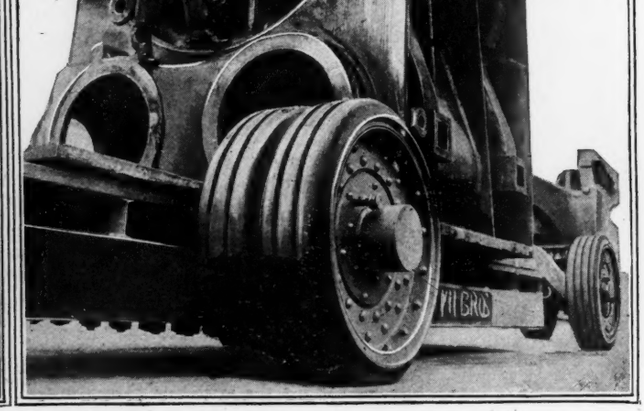


Efficiency is the key-note of the modern repair shop. This proprietor made his own crane and saved money thereby

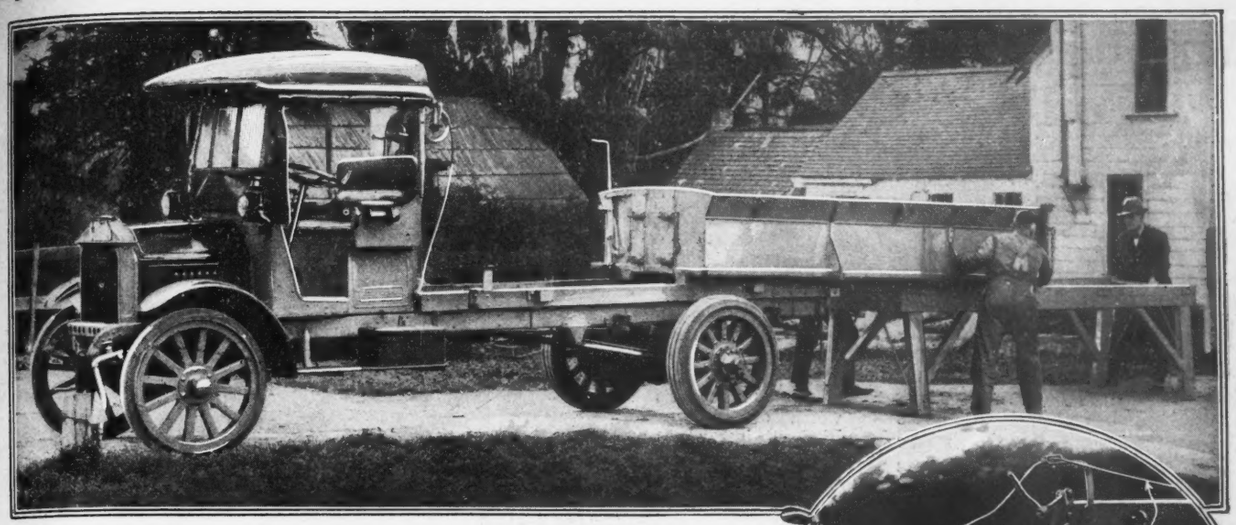
Heaviest Load on Rubber Tires

WHAT is said to be the heaviest load ever carried on rubber tires is the forty-ton marine engine cylinder shown below. This tremendous load was recently hauled for twenty-three miles over the streets of Los Angeles to San Pedro without damage to the streets or to the rubber tires on which the carrying trailer was mounted. The trailer was specially constructed for the work, and will safely carry as much as fifty tons.

The load was so heavy that two tires, each ten inches wide and forty inches in diameter, were placed side by side on each built-up metal wheel.



Hauling forty tons for twenty-three miles on rubber tires is the unusual stunt of a Los Angeles truck. The tires were uninjured



Special truck bodies for certain types of work are receiving the attention of large manufacturing concerns. Here is a body that is easily removable

It Can Be Removed for Platform Work

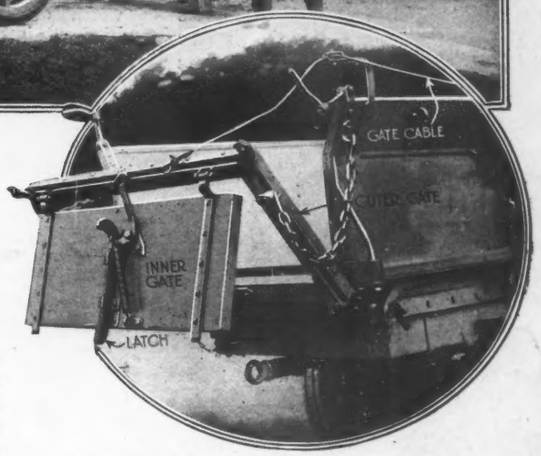
WHILE the large increase in the use of motor-trucks in the United States and the great multiplicity of their tasks has resulted in several firms bringing out truck bodies that are readily convertible from one form to another, as shown in recent issues of POPULAR SCIENCE MONTHLY, it is unusual to see an express type of elevating body that may be removed entirely from the chassis without considerable work. However, the body shown in the accompanying pictures is just such a body, and may be rolled off the truck chassis frame in four minutes' time to enable logs to be carried.

The body shown was made on special order for a California farmer who wanted to use his truck for bringing express shipments from the station; to carry road material used for the maintenance of drives; and to carry unwieldy objects, such as crooked parts of trees, roots, etc. To satisfy the demands for the express service, a simple type of flareboard body was sufficient. But for carrying bulk material some means had to be provided for elevating it, so that the material would run to the rear end.

This was accomplished by fitting a conventional type of hydraulic hoist just in back of the driver's cab. But, in order to spread such material evenly on the ground, a special form of double tail-gate was provided. This is a gate within a gate, the outer being hinged at the two bottom corners and the inner at its two upper ends. The opening of the inner gate is controlled from the driver's seat.

So far, the body is not so much out of the usual; but when provision is made to remove it entirely from the chassis it becomes distinctly different.

In the first place, the connection between the vertical lifting cables of the hoist and the front end of the body may be broken readily because the ends of the cables are formed into loops which are slipped over hooks in the body. The entire body may be slid off the longitudinal wood sills on top of the truck frame proper and the body sills used for carrying lumber.



The tail-board operates on two sets of hinges, one to permit sand-load emptying, the other for sliding out heavy material. A hydraulic hoist raises the front end

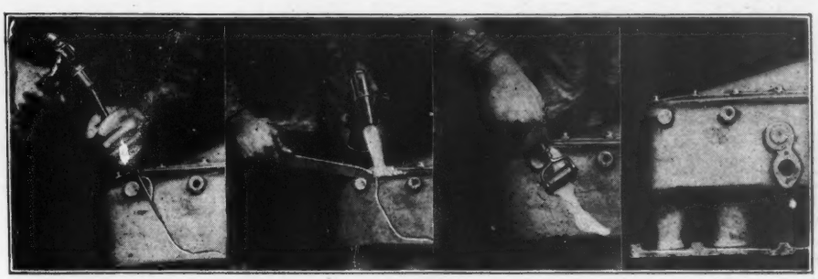
Brazing Cracked Castings at Low Temperature

THE discovery of a new low-temperature brazing compound, called nicro-spelter, makes it possible for even the least skilled mechanic to braze together cracked castings made of iron, bronze, or brass. The new compound, worked out by K. R. Peters, of Chester, Pa., melts at 300° F., brazing perfectly. This comparatively low temperature may be secured by the use of an ordinary blow-torch.

The compound has been found especially suitable for automobile work. The four views shown here illustrate the four steps necessary in repairing a cracked engine water-jacket.

First, the crack must be cleaned thoroughly, and the edges beveled off to form a V, to give the added material sufficient body to hold it in place. Second, the material along the line of the crack is heated for a moment with an ordinary hand blow-torch and the spelter run into the crack.

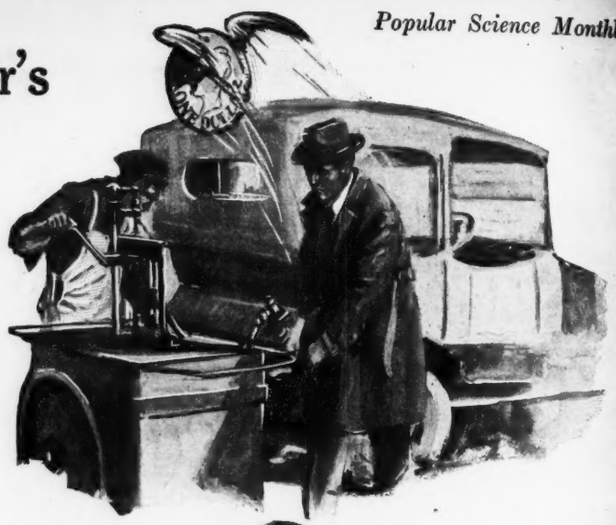
The third step is to roll the compound flat or flush with the surface of the casting while the former is still hot. This is done by means of a small roller similar to that used by stationers in pasting paper together. After the casting has been allowed to cool off for about five minutes, it is necessary only to dress off the surface with a file to complete the repair.



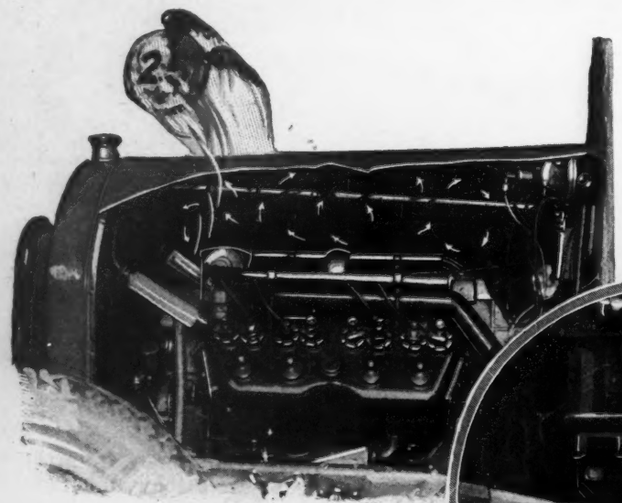
A new compound for brazing iron, bronze, or brass castings melts at 300° F. It is permanent and wear-resisting, and can be worked by an unskilled mechanic

What Becomes of a Dollar's Worth of Gasoline

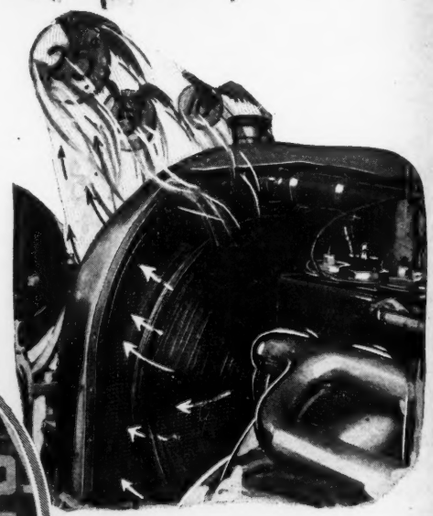
As your automobile purrs sweetly along the road, do you ever try to figure the gasoline inevitably lost by your engine before it gets a chance to transmit power to the driving wheels? Not more than twenty per cent of the energy in the gasoline is delivered by the average automobile engine, although twenty-five per cent is attainable. Here's a series of pictures showing where the leaks are and how to stop them



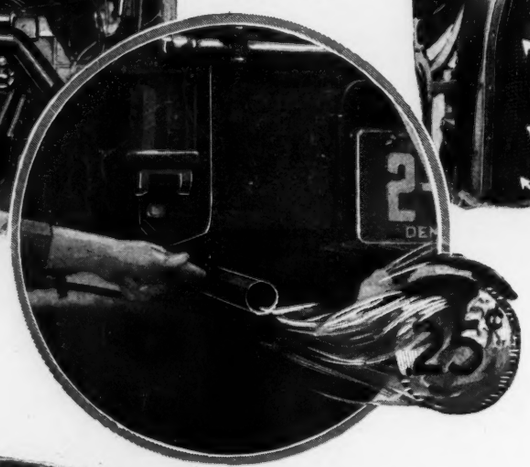
The garageman churns out a dollar's worth of gasoline. Find out just where it goes and how it could be economized



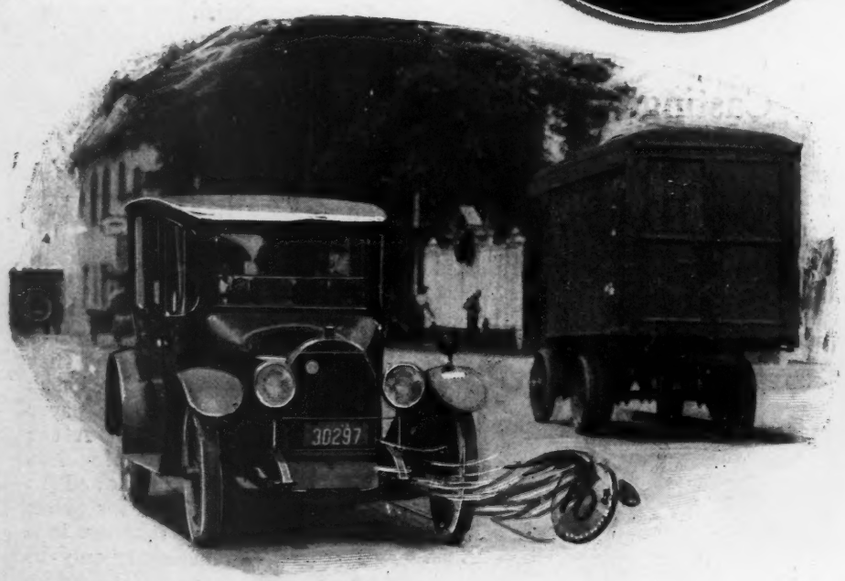
Twenty-five cents of your dollar is ejected in smoke from the exhaust. Adjust the carburetor to its highest efficiency; hold the oil at a constant level; and beware of black smoke



Twenty-five cents of the dollar mixes with the air that circulates over the engine. Moral: Never race the engine and never allow it to idle. Battery recharging is cheaper than purchasing gasoline



Forty cents of your dollar emerges from the radiator. Keep the cooling system in perfect condition and the engine as cool as possible. In addition, make sure that the fan is functioning properly



Only ten cents of your dollar drives the car over the road. Manipulate the hand throttle when driving over rough roads. Coast whenever possible on grades and hills

And now you must buy more gasoline. Attach a safety cap to your filler tank, and have some means of making sure that you get a full gallon

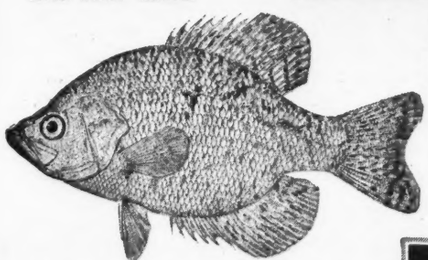
Where the Pearl Button Gets Its Start

THE pearl buttons that you buy for your clothes are obtained from the shells of the fresh-water mussel. A lively mussel-fishing industry has sprung up along the banks of the Mississippi river and its tributaries. The mussel-fishermen go out, praying that they will find pearls worth, it may be, as much as three thousand dollars apiece. Once a year or so they find a pearl or a slug. But even the shells, which are thrown to one side and sold to pearl button makers, are worth twenty dollars a ton. What becomes of the dead mussels? Oh, they are thrown to the pigs or the chickens, or used as fish bait

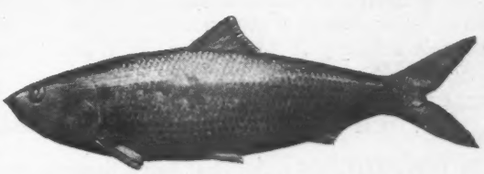
The story of your pearl buttons begins with the infection of a fish with the larvae (glochidia, the scientists call them) of the mussel. The larvae, it seems, are expelled by the parent mussel, and attach themselves to the gills, fins, or other parts of fish unfortunate enough to be swimming around at the time. The men in the picture above are scientists who are sorting the fish that are to be infected with the larvae or glochidia of the fresh-water mussel

A flat-bottomed, square-end boat, commonly called a John-boat, is employed. Two long iron bars are carried, to which are attached by short lengths of cord some one hundred hooks. The fisherman throws one of the iron bars overboard. As soon as the hook enters the open shells of a feeding mussel, the shell closes tightly

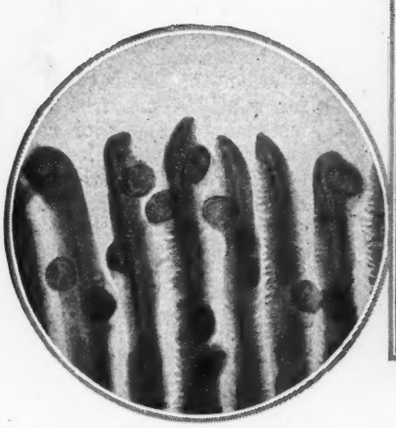
Since the larvae of mussels thrive on the gills of fish, we find that the Bureau of Fisheries has developed a method of collecting the fish in nets and transporting them to infection tanks, into which the larvae are introduced. It takes only a few minutes for the lively little larvae, or glochidia, to establish themselves in these free boarding-houses. The fish are liberated in ponds, all unconscious of the part they are playing in buttoning up mankind



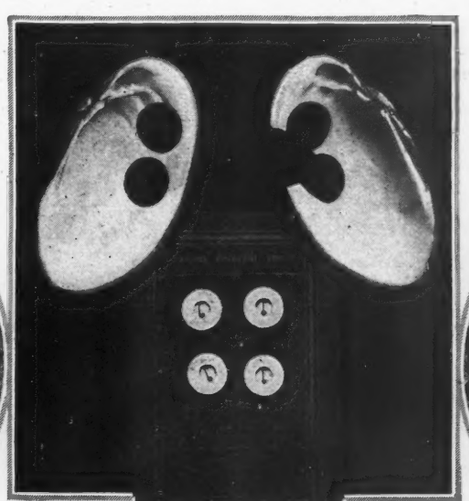
The black crappie carries the glochidia of several species of mussels and thus serves as an unwilling host



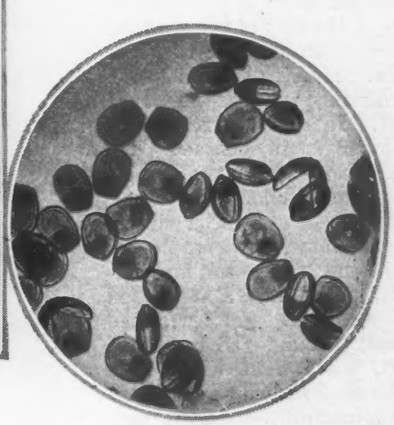
The glochidia of the "nigger-head" mussel, one of the most valuable commercial species, are the special uninvited guests of this river herring. The scientists also supply large-mouthed black bass and other varieties for the glochidia



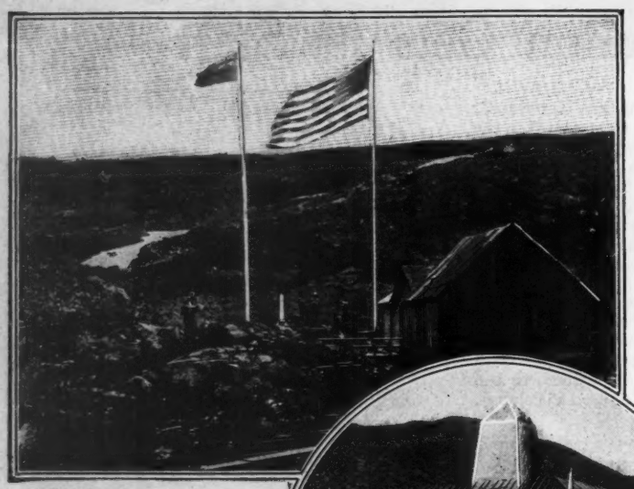
The little specks are the glochidia, or larvae, of pearl mussels; the straight finger-like projections are the gills of a fish. Behold the glochidia at home



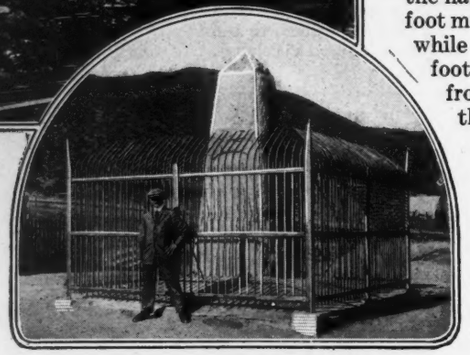
These buttons were cut from shells of mussels raised from the glochidia stage in the ponds of the Fairport Biological Station, of the Bureau of Fisheries. All of which shows what science is doing in the matter of your personal adornment



Here the glochidia—the beginnings of so many pearl mussels—are drifting around looking for a home. Eventually they will find it in the gills of fish



The posts on the Canadian border are guarded simply by the flags of the countries



A stone post marks the border between the United States and Mexico; this man has a foot in each country

Where the U. S. Ends

THE Mexican and Canadian border lines of the United States are not lines at all, but rather a series of posts. The posts along the Mexican border are carefully caged in—perhaps to prevent anyone from moving the border. Our illustration shows an American performing the exciting feat of standing in two countries at one time.

On the Canadian border the posts are unguarded except for a flag-pole on either side, each of which flies the flag of its country.

One of the interesting features of national borders is that a fleeing criminal is out of the hands of the police once he has taken a step across. Though the police may be able actually to touch him, they cannot legally do so.

When You Can't Move That Bolt

AUTOMOBILE parts that have become over-tightened, such as nuts, bolts, or spark-plugs, are sometimes very difficult to remove, especially when they have become rusted into position, and when the use of excessive force may damage and possibly cause some breakage to the parts.

If the tightened part will not loosen under ordinary pressure, pour a little kerosene at the seat of the trouble, giving it ample time to penetrate. If this does not prove successful, try the effect of heat. In case the refractory member is in contact with the cylinder, run the engine for a short while.

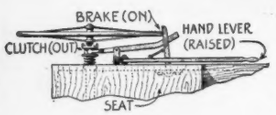
In other cases a blow-torch may be employed. When no blow-torch is available, a bit of waste soaked in gasoline and wrapped loosely around the tightened part, when lighted, will heat the metal sufficiently to ease the joint and permit the part to be removed.

Throw Out the Clutch and Coast

NO wonder she smiles! J. B. Allen, of Pueblo, Col., has just made her a hand-car that has a coaster-brake, and also a curved bar attached to the handle for exercising her left foot, which is paralyzed.

As she moves the handle her left foot moves with it, while her right foot rests on the front axle to do the steering. The coaster-brake is worked by a lever, which she now holds in her right hand. When she pulls the lever up, a clutch that engages the spokes of the wheel is withdrawn, and the car coasts. The brake is applied by the same lever. When she pulls it a little higher, a bar comes down on the rim of the wheel, causing the car to slow down or stop entirely, depending on the amount of pressure used.

After watching this little girl ride around in her car, a man who was also paralyzed ordered a somewhat similar one for his own use.



Her hand-car is supplied with a coaster-brake; it also has an attachment specially designed to exercise her paralyzed left foot

Chalking the Chalk-Line

WHEN is a shoe not a shoe? When it is a chalk-line holder like that invented by John S. Wakimoto, a Japanese resident of Grand Island, Neb. Look at it. It has the form of a woman's low shoe, with a pointed toe and high heel; but there the resemblance ceases.

The recess opening is closed with a felt stopper, which on being pressed down brings the chalk in contact with the line

The chalk-line, when not in use, is wound around the drum of a reel which is placed in a recess of the wooden shoe between the heel and the instep. The line passes through a channel running lengthwise through the shoe to a forward recess which contains chalk, and thence through an opening in the tip of the toe.

When the line is to be used for marking, the free end is fastened to a peg or a nail, and the required length of line is reeled off the drum. As the line is pulled out, it comes in contact with the chalk and is coated.

After the work is completed, the line is again wound around the drum of the reel. Before the line reaches the reel, the surplus of chalk is brushed off by a feltlike pad over which the line must pass.

This chalk-line holder and reel does not have to be in the form of a woman's shoe. It would work just as well in any other shape, if essential parts were unaltered

Locomotives Are Consuming Too Much Coal

But a feed-water heater has been invented that will save at least ten per cent of every shovelful

By Joseph Brinker

THERE is a tremendous waste of coal in firing locomotives. Cold water is sucked from the tank in the tender by means of an injector and fed into the boiler. The heat generated by the burning coal turns the cold water into hot water and then into steam. The steam is fed to the cylinders, at high pressure, and its power is transformed into motion by reason of its impulse to expand and push on the pistons connected with the driving mechanism of the locomotive.

Heat Goes Up the Smokestack

The exhausted steam, having done its work in the cylinders, is blown away through the smokestack, carrying with it sixty-five per cent of the heat consumed in changing the coal to steam.

To avoid at least part of this waste, a feed-water heater is employed in many modern locomotives. The heater returns to the boiler some of the waste heat of the exhaust steam, and thereby saves at least ten per cent of the coal bill.

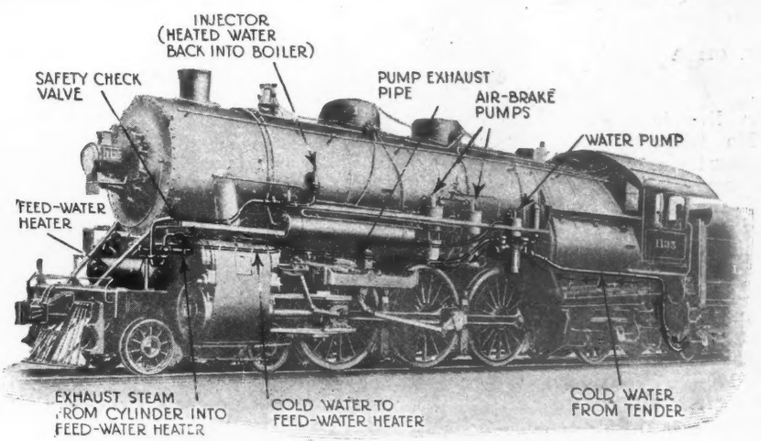
In other words, nine pounds of coal, together with the feed water heater, does the same amount of work as ten pounds of coal in the average locomotive without the heater will do. A saving of 10 per cent of a substance as valuable as coal has become is no mean achievement.

How the Feed-Water Heater Works

The feed-water heater, which is shown on this page, takes one sixth of the exhaust steam ordinarily sent up through the smokestack, and utilizes it for heating the water before it is fed into the boiler. Five sixths of the steam is sufficient to provide the necessary draft for the boiler fires.

The one sixth used to preheat the water saves about thirteen per cent of the heat in the exhaust steam. By putting this back into the boiler ten per cent of the coal burned is saved.

The feed-water heater is a cylindrical tank, which is generally placed just ahead of the front end of the boiler, directly on top of the cow-catcher framework.



By making use of some of the exhaust steam of the locomotive for preheating the water that is fed to the boiler, the cost of coal for an engine can actually be reduced ten per cent

The feed-water pump forces the cold water from the tank in the tender to the intake of the heating tank, where it passes through a series of tubes around which exhaust steam, taken from the valve chests of the engine cylinders on each side of the boiler, is allowed to circulate.

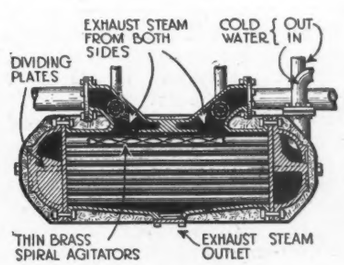
The Water Is Preheated to 250° Fahrenheit

The steam heats the water as it passes through the pipes, so that when the water reaches the boiler it has become so hot that little additional heating is required to change it to steam of adequate pressure. When the exhaust steam gives up its heat to the cold water in the pipes, part of it is condensed to water, which is drained off at the bottom of the tank.

The heater is closed, and will therefore deliver water to the boiler at a temperature proportional to the back pressure in the engine cylinders. In an open vessel water boils at a temperature of 212° Fahrenheit. But when a locomotive is running at high speed the back pressure in the cylinders is sometimes as high as fifteen pounds.

At such times the exhaust steam may have a temperature of 260°. When this is the case, it will heat the water to a temperature of 230° or 250° before it is fed to the boiler.

Since the water passes through the tubes while the exhaust steam circulates around them, it remains free from the vaporized lubricating oil that is invariably contained in exhaust steam. If the oil vapors were pumped back into the boiler they would form a heat-consuming scale on the boiler-tubes.



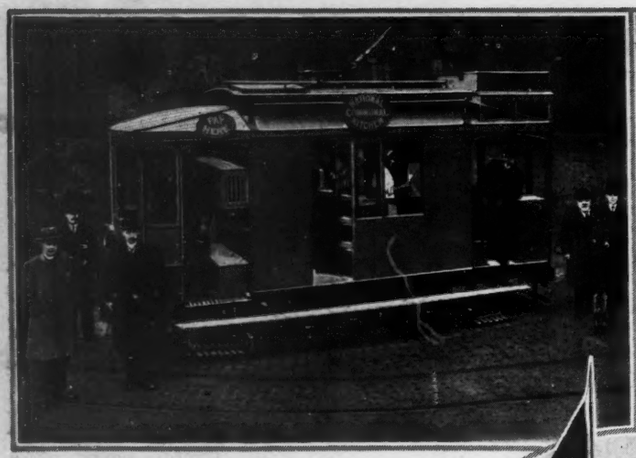
When the water reaches the boiler it is so hot that it needs only a little additional heating to change it to steam of the adequate pressure

A Removable Head Provided at Each End

For the sake of greater convenience in cleaning the heater, a removable head is provided at each end.

The tubes are nested in four distinct groups, separated from one another by plates which divide the interior of the heater into four longitudinal sections. On its way to the boiler the water passes through each of the four compartments. This means that it has to pass through sixteen feet of tubing, while the length of each of the four units is only four feet.

To bring each part of the water into contact with the heating surface of the pipes, spirals of brass are provided in each pipe. These rotate at high speed as the water passes through the pipes.

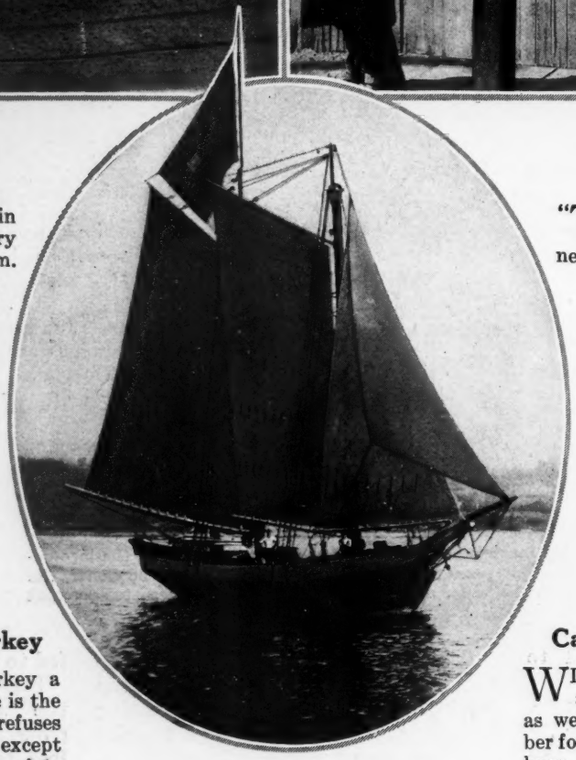


A Traveling Kitchen on a Trolley Car

HAPPY folk, they who live in Halifax, England! No worry about buying supplies or cooking them. All they have to do at meal-time is to carry the dishes out to the trolley track and wait for the traveling kitchen to come along.

Alderman Charles F. Spencer, Director of National Kitchens, is father of the idea. He took an old trolley car, fitted it up with electric ovens, steamers, hot plates, and boiling-pans; installed a 100-gallon water-tank on the roof, and sent the car on its journey.

The car cooks as it travels, taking its energy from the overhead trolley.



Taming the Bolshevik Turkey

MOST of us consider the turkey a domestic fowl. He is not. He is the Bolshevist among farm birds. He refuses to submit to barn-yard government except when feed cannot be obtained by foraging.

To keep his turkeys out of the neighbors' corn-fields, one farmer fitted up an attachment that at first glance looks like a turkoplane. It is merely a board fitted around the turkey's neck and tied by a heavy cord that passes under the wings.

The World's Oldest Wooden Vessel Still Afloat

IN 1805 the *Polly* first sailed the ocean blue, and she is still doing it. Her birthplace was Amesbury, Mass., and since the first moment she took the water she has been working as a coastwise freighter.

Several years ago, when the *Polly* began to grow famous for her long, active life, the newspapers—as so often happens—hunted for possible scandals in her youth that they might feature in their pages. They came out with the story that in the War of 1812 she was a privateer. But this was promptly and indignantly denied by her friends. So the newspapers gave up and the *Polly* has gone on her peaceful, respectable way.

The schooner has a capacity for only forty-five tons freight; yet in her day she has carried enough lumber, bricks, and lime to build a large city of wooden houses. Think of the long line of captains who have sailed the *Polly* and the crews that have manned her through more than a hundred years. What human interest stories she could tell if she could only speak.

Take Heed, All Ye that Enter Here

"THE greatest safety device known is a careful man," says the sign near the approach to a certain time-card rack; and to impress the need of care on the careless, a railroad that has made a specialty of "Safety First" campaigns has installed the sign-board turnstile. shown above.

Workmen must pass through the stile. The time-card board where they get their cards on entering in the morning is so placed that as a workman halts to get his card he is confronted by the turnstile, where a board at the level of his eyes carries in three languages the warning to BE CAREFUL.

Carry a Bed in Your Pocket

WITH air cushions such as this the Japanese make easy the seats of the lowly as well as of the mighty. Lacking rubber for such purposes, they make punching-bags, bed mattresses, water vessels, and air cushions of a strong bamboo fiber sometimes called "leather-paper." It is very tough as well as light, and has so little bulk that one might easily carry his bed in a good-sized coat pocket.

The material is shellacked and built up in layers, the grain of each layer crossing its neighbor. The product is water-proof. The pillow below has been in use fifteen years.

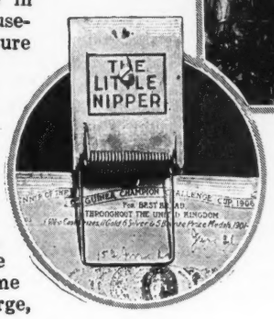
© Keystone View Co.

Mosquito-Masks for Gold-Miners

HOW the hardy forty-niners who first made the gold pan famous would laugh to see how particular these nineteen-nineteeners are! But then, the Argonauts of California never met the fierce mosquito of Alaska. Everything grows big in Alaska, including the mosquito.

It Traps Bills instead of Mice

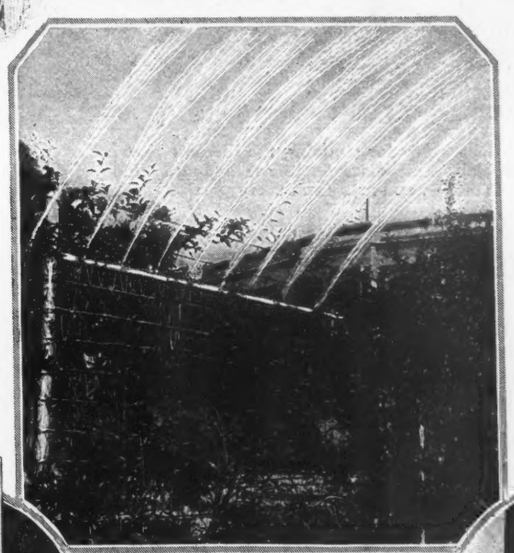
AS a reward for catching all the mice in the house, the mouse-trap shown in the picture herewith, was promoted from its place on the floor to a nail in the wall. Now it catches bills, which are not nearly so messy. What is more, the mouse-trap has been given a name — "The Little Nipper"; and its name is painted on it in large, plain letters.



Before the mouse-trap took up its new post, of course, it was thoroughly washed and all the unnecessary parts were removed.

Iron Pipe Makes a Good Sprinkler

SOMEBODY attached to the Arroyo Seco library and playgrounds in Los Angeles had a bright idea. In order to sprinkle the rose hedges and vines in the grounds with little trouble, a ¾-in. pipe was perforated at intervals and placed on top of the fence. The pipe was then given water connection; and now, when the water is turned on, the entire hedge and border of flowers is sprinkled. Another length of perforated pipe takes care of the library terrace.



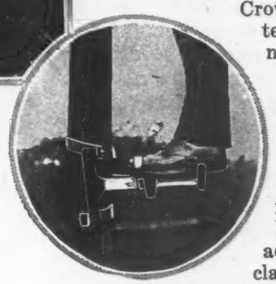
He's Taking His Lesson in the Flipflap

THE music begins, the curtain rises, and out come the acrobats. As they tumble, twist, and turn, you wonder how they are able to do it so easily. But this easy performance comes only after long practice.

Take, for instance, the flipflap. In learning to do this, he puts on a belt, which is fastened by a rope to the wall. He bends back until he touches the floor; then the instructor jerks the rope upward, bringing the acrobat into an upright position.

Walking Up an Iron Pole

BY means of a climbing apparatus invented by Mr. Crowther, of Manchester, England, it is now possible to go up an iron pole quite easily. The apparatus consists of two clamps, one for the feet and one for the hands. First the climber adjusts the lower clamp and stands on it; next he clamps on the upper one, which has projecting handles and to which a waist-strap may be attached. After grasping the handles firmly he pushes the lower clamp upward with the feet. Thus, by adjusting first the foot clamp and then the hand one, he walks up the pole.

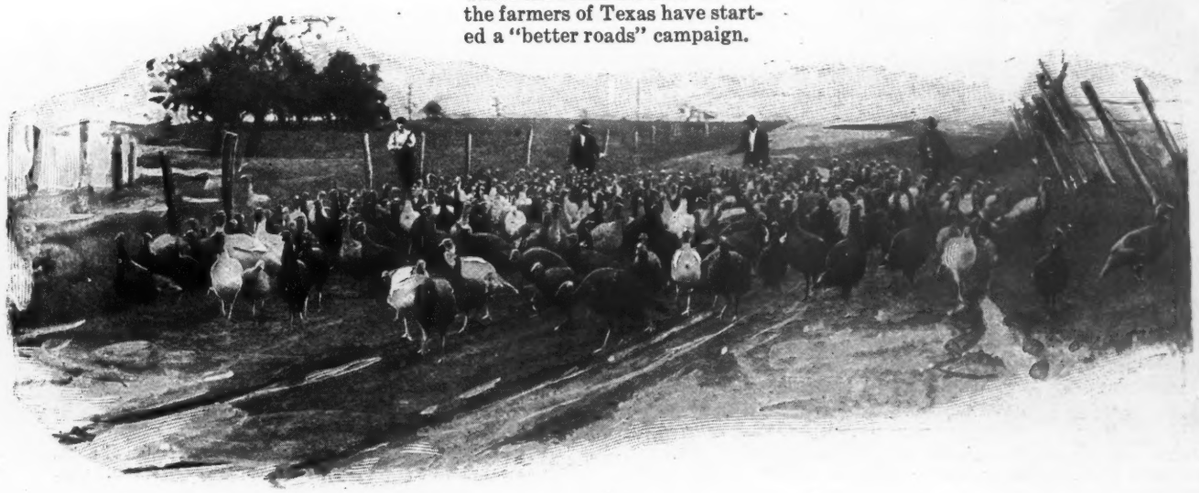


The Real Turkey Trot

A CONDEMNED man's last moments are made as easy for him as possible; but a condemned turkey must suffer.

In the first place, he is usually made to walk from the farm to the railroad station. Then he is stuffed into a freight-car with too many of his brethren. If the roads are rough and full of ruts he becomes foot-sore.

"Is this fair?" cry the tender-hearted poultrymen of Texas, where the roads are bad. And so the farmers of Texas have started a "better roads" campaign.

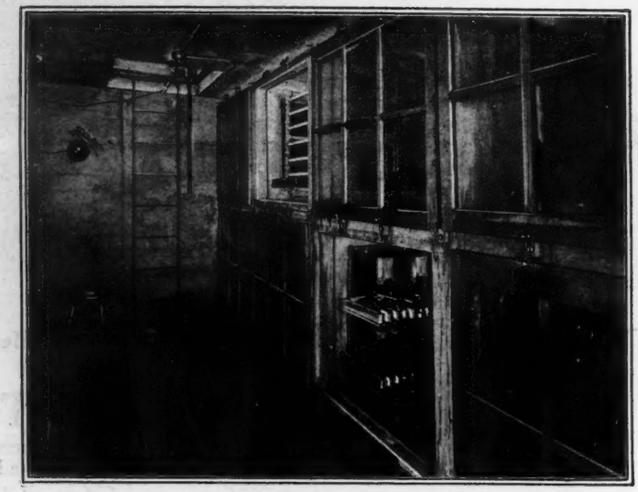


The Dungeon of Rot—A Sinister and Odorous Place

IT'S unhealthy. You are certain of that the instant you step inside the door. A wave of air with a humidity of something over ninety-nine per cent, and as hot as Sumatra in July, makes you long for an electric fan. Besides, there are smells—smells woody, earthy, and slimy.

A long line of glass-doored cupboards confronts you. On the glass hang beads of perspiration. As you tentatively open one door you realize where all the odors are coming from.

Fungi of all shapes, sizes, and colors hang on pieces of decaying wood therein. A few are of the conventional "sunshade" type, brown on top and sickly white underneath. Here is another, a whitish gray arm, twining itself around a hickory branch. All the kinds of wood-rot in the United States are represented here.



A laboratory for studying the diseases that attack wood. Behind these glass doors are kept all kinds of sinister exhibits—wood-rots from every part of the United States

It is the laboratory of experimental wood pathology of the Forest Products Laboratory at Madison, Wis. Here are kept all the diseases that can attack wood, and wood is inoculated in order to demonstrate the effect of different toxins. The toxins are mainly mineral poisons, which may safeguard various kinds of wood against rots, if the tests result satisfactorily.

Millions of Dollars in the Despised Corn-Cob

By S. R. Winters

THE picturesque spectacle of the grain-dealer of the middle West carting corn-cobs to the river-bank and inviting the high tide to sweep them away, and the old-fashioned corn miller of the South banking them in the mill or choking the narrow-gaged stream with them—these time-honored practices are destined to a speedy end.

Corn-cobs — heretofore considered the veriest waste—are to be salvaged and made into glue. Moreover, the grain-growers of Ohio, Indiana, and other middle Western states may soon be shipping eggs across the continent, or perhaps to Siberia, in containers welded together by corn-cob adhesive.

America is the world's chief producer of corn, the annual yield ranging between two and a half and three billion bushels. For every bushel of shelled corn there is approximately one bushel of cobs; and one hundred tons of cobs will yield thirty tons of glue.

"Imagine all the available corn-cobs transformed into profitable uses, and there would be enough glucose to fatten all the cattle raised in the United States or a source capable of yielding all the alcohol used; a supply of baking powders sufficient to 'raise' all the biscuits ever baked; and there would be no such shortage of acetic acid as exists today."

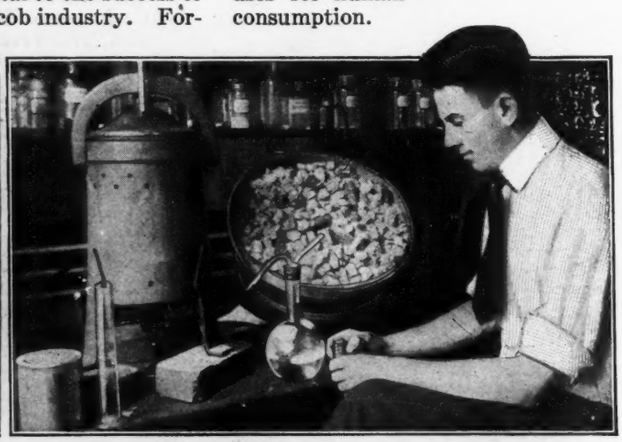
Sounds like a fantasy or a tale from Arabian Nights? Not so—we quote Dr. Frederick B. La Forge, chemist in the Bureau of Chemistry, United States Department of Agriculture. He has successfully developed the process of making corn-cob glue.

Since corn-cob glue is to compete with the cheapest variety of adhesive and is to be used principally in making fiber containers, the proximity or remoteness of fiber-manufacturing plants is fundamental to the success or failure of the corn-cob industry. Fortunately, in the middle West fiber-container manufacturing enterprises are thickly clustered.

Corn-cob adhesive would take the place of sodium silicate (water-glass), a glue obtained by fusing soda and sand. The mixture is used exclusively as an adhesive, and is expensive. The product commands from forty-five to fifty dollars a ton. In cheap corn-cob glue of high sticking qualities sodium silicate finds a rival. Fixing the price of coal at five dollars a ton, and estimating the cost of delivering the cobs at the manufacturing plants at three dollars, the finished product could be made for eight dollars a ton.

Three per cent of the yearly production of corn-cobs would supply adhesives equal to the combined consumption of today. Hence the quantity of raw material appears limitless. Moreover, starch, dextrine, and flour paste — components of foodstuffs — would thus be diverted to their normal uses for human consumption.

Recent experiments by chemists show that in wasting corn-cobs we have been throwing away millions of dollars every year

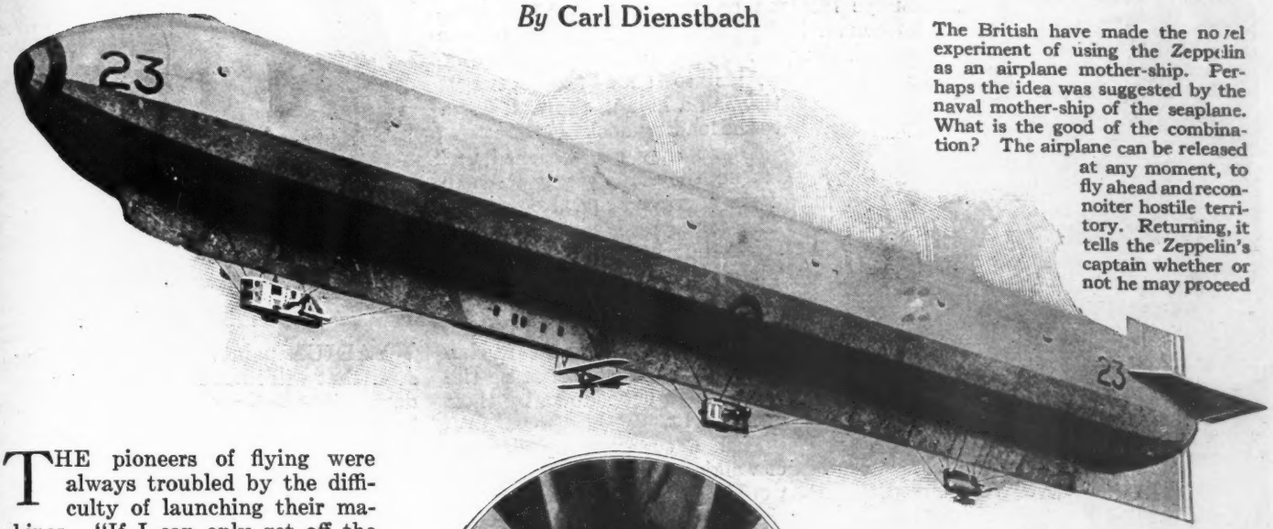


For every bushel of shelled corn there is a bushel of cobs; one hundred tons of cobs make thirty tons of glue

Mothering the Airplane with the Zeppelin

How the British launch airplanes from their giant dirigibles

By Carl Dienstbach



The British have made the novel experiment of using the Zeppelin as an airplane mother-ship. Perhaps the idea was suggested by the naval mother-ship of the seaplane. What is the good of the combination? The airplane can be released at any moment, to fly ahead and reconnoiter hostile territory. Returning, it tells the Zeppelin's captain whether or not he may proceed

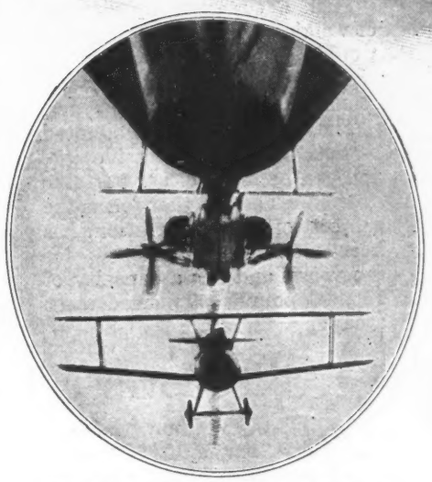
THE pioneers of flying were always troubled by the difficulty of launching their machines. "If I can only get off the ground," each one of them said to himself, "I will fly." Dozens of machines were wrecked before the trick was learned.

Now, the Zeppelin dirigible had been brought to virtual perfection somewhat before the pioneers of flying had fully solved the problem of launching. Why not launch a flying-machine from a Zeppelin? The suggestion was made over and over again. It seemed easy to start the airplane from a speeding rigid dirigible, for the wings would receive both the speed and the support that they need, with no interference from wind-gusts.

The non-rigid type of dirigible would hardly have lent itself to the purpose; it could not lift enough. But the plan was well worth trying with a Zeppelin traveling very low over a flying-field. Probably the test was never made, because the art of handling a Zeppelin in the air was acquired only with difficulty after years of experiment. The early Zeppelin navigators had troubles enough of their own without risking lives in launching a flying-machine.

With the modern Zeppelin and the modern airplane the result of such an experiment is a foregone conclusion. An airplane could be dropped even from a captive balloon at this late day, and the balloon would hardly be endangered by the sudden release of so much weight. Have not the fighting flyers shown that they can control their machines when they are dropping tail first, or slipping down sidewise, or looping the loop?

What would be the good of the proceeding? Would the airplane serve as a kind of life-boat? Hardly. It could not carry enough weight. On the other hand, a small airplane would have its uses. Piloted by an "ace," it might give battle to an attacking airplane or carry out a reconnaissance over hostile territory.

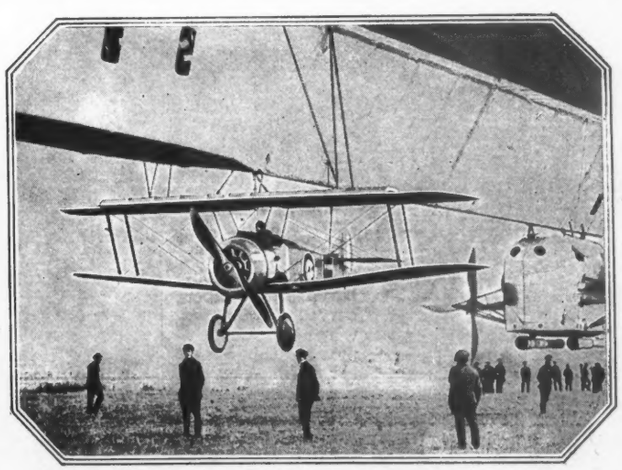


Dropped from a Zeppelin in a flying-machine! He can return when he pleases and hook himself to the Zeppelin mother-ship; but the trick requires skilful piloting and a nice regulation of air-speed

This idea of using the giant rigid dirigible in connection with an airplane has been practically tested by the British. No doubt the British experiences with naval mother-ships for seaplanes suggested the possibility of converting the Zeppelin into a similar craft. Considered as a mother-ship, a Zeppelin becomes a formidable fighter and a most efficient scout. Use the Zeppelin as a mother-ship, and the advantages of airplane and rigid dirigible are perfectly combined.

Not only can the airplane leave the Zeppelin in full flight at any instant, but it can return just as easily. The dirigible has but to run at top speed and the plane at its low speed. The two vessels leisurely come together. Blériot hooked his moving plane even to a stationary wire years ago. Lieutenant Locklear has shown how easy it is to leap from one plane to another.

The more we consider the possibilities of the Zeppelin as a mother-ship, the more we wonder why the Germans did not carry out the idea. It remained for the British to reveal its possibilities. The Germans might have made similar experiments for the last ten years; but apparently they lacked the imagination that was necessary.



Does the carrying of an airplane by a Zeppelin in this fashion impose an unnecessary additional burden? Not at all. The airplane wings can be so inclined that they exert their maximum lift, and the airplane engine may be permitted to run

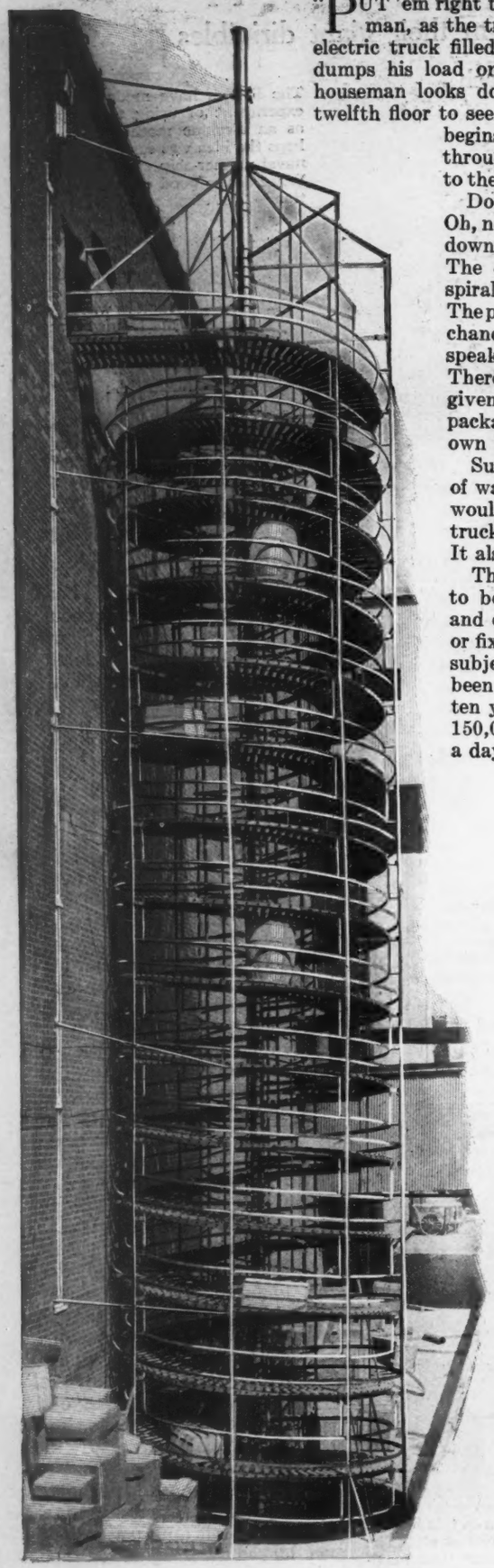
Shooting Meat Down a Chute

"PUT 'em right there!" says the warehouseman, as the truck-boy slides up with his electric truck filled with packages. The boy dumps his load on the floor, and the warehouseman looks down from his eyrie on the twelfth floor to see that all is clear. Then he begins to slide the packages through a hole in the wall down to the loading-dock below.

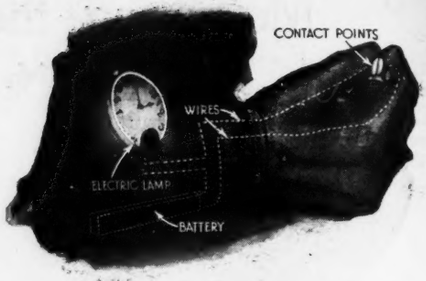
Don't they get smashed up? Oh, no; they slide gently to earth down a gravity spiral conveyor. The conveyor is not necessarily spiral, but it is always inclined. The platform upon which the merchandise moves is paved, so to speak, with ball-bearing rollers. There is just sufficient incline given to the track to cause the packages to slide down by their own weight.

Such a conveyor saves miles of walking and hours of time that would otherwise be spent in trucking and in elevator service. It also economizes on floor space.

The conveyor can be adapted to both inside and outside use, and can be made either portable or fixed. The one that forms the subject of our illustration has been working continuously for ten years, and has a capacity of 150,000 pounds of packed meat a day.



Down this slippery path one hundred and fifty thousand pounds of meat passes every day



Want to see the time in the dark? Then carry your watch, an electric light, a battery, and wires inside your motorist's glove

Night-Time—How to See It

RADIUM paint is not the only thing that will illuminate a watch on a dark night. So saith Benjamin F. Lockwood, somewhat defiantly, for he has just invented a decidedly complicated device for so doing.

In the first place, you must wear a motorist's glove; then you attach your watch to the back of the cuff; next you adjust the bulb and shade so the watch is illuminated. A battery is tucked in the side of the glove, and wires run around till they terminate in two contact points in the thumb and first finger.

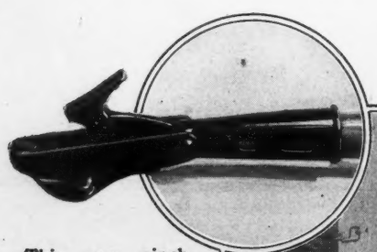
When you wish to see the time, act as if you were pinching someone and the lamp will light.

It Moves a Loaded Freight-Car

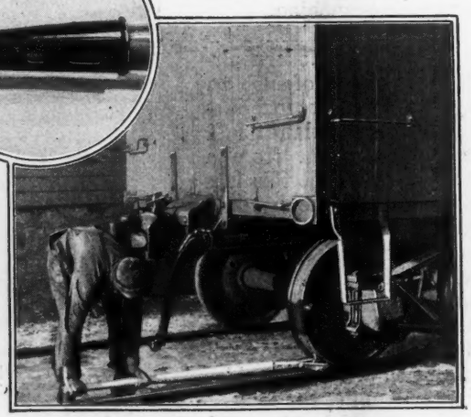
DO you know what a pinch-bar is? It is somewhat like a crowbar, and it is used for moving loaded freight-cars. It is pushed between wheel and rail and a prying motion causes the wheel to revolve.

In the old-style pinch-bar much force is wasted in lifting the wheel instead of pushing it. This is overcome in a new pinch-bar.

This tool consists of a shoe that fits the top of the rail and is braced against the track; the pinch-bar proper, which is pivoted at its bend to the shoe and has a strong wooden handle; and a member shaped to fit the curve of the wheel and pivoted to the end of the pinch-bar. When the handle of the pinch-bar is pushed downward, the curved member engages the rim of the wheel and changes the vertical force exerted by the short end of the lever to a horizontally acting, pushing force.



This new pinch-bar has a member curved to fit the wheel. Under pressure this member will convert the lifting force into a pushing force



With the aid of the improved type of pinch-bar one man can easily move a loaded freight-car

Putting Bad Smells to Good Use

HOW do you know that a skunk has invaded your neighborhood? That the family next door is going to have ham and cabbage or steak with fried onions for supper? Or that a gas-pipe is leaking?

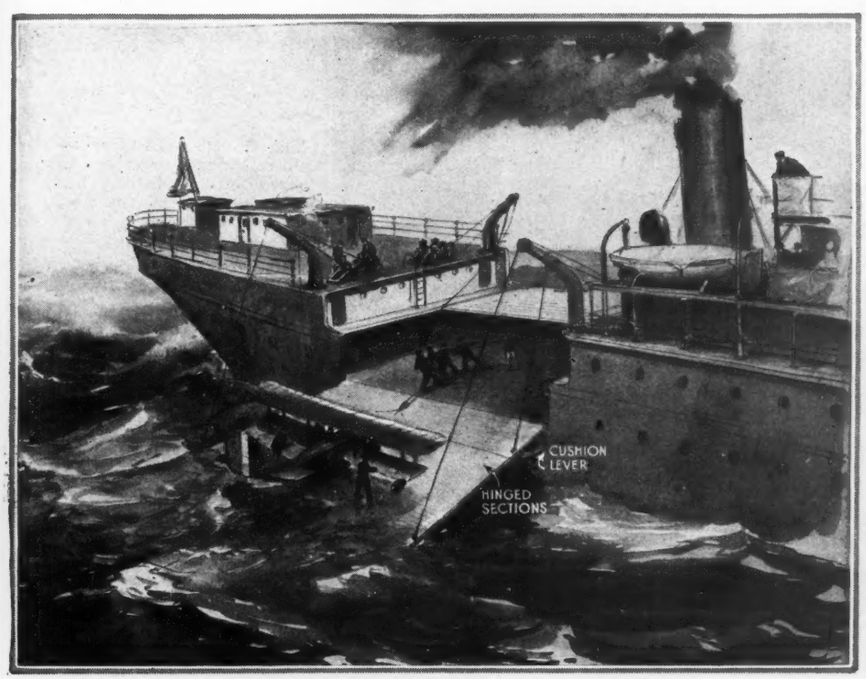
The keenness, alertness, and reliability of the human nose as a detector of smells, good and bad, suggested the idea of using distinctive odors for conveying warning signals to workers in mines and factories. The United States Bureau of Mines experimented with a number of substances of pronounced pleasant or unpleasant odor, and found several exceedingly offensive stenches, powerful at low concentration, particularly suitable for use in mines. The substance, in the form of gas or vapor, is mixed with the air that is forced through the mine for ventilating purposes. In a few moments the stench-laden air permeates the mine, and the miners are given an opportunity to save their lives.

The first whiff of stench-laden air warns them of danger

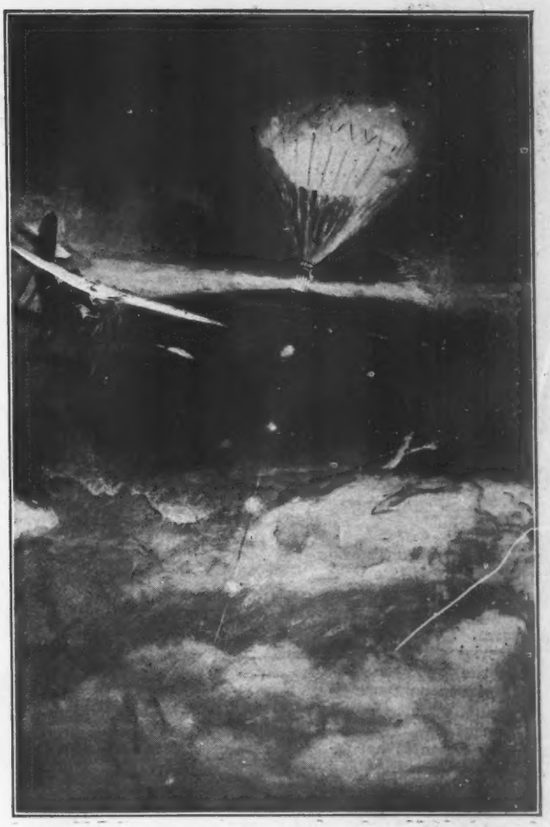
Some stenches, like amyl thioether, allyl isothiocyanate, amyl isovalerate, phenyl isocyanate, and isobutyl mercaptan, can be detected in a dilution of 0.2 to 3.5 in one million parts of air by volume, and are strong when diluted at a ratio of 1.7 to 11 parts by volume in one million parts of air.

A Sea Home for the Seaplane

A FLOATING hangar—a ship with seaplane-landing facilities—has been invented by Maximilian C. Schweinert, of Hoboken, N. J. The seaplane lands on the water and taxis toward the ship, whereupon the ship lets down a gang-plank. If it has wheels, like some of the German "Gothas," the seaplane taxis up the gang-plank into her berth. Then the gang-plank is raised to an upright position, in which it serves as the door of the berth.



A gang-plank is lowered from the side of the ship to the water and the seaplane rides up to her berth within the hull, which is fitted up as a hangar and repair shop



In spite of the dense fog below, the aviator would find his home field by means of an illuminated balloon; the lights strung down the cable guide him to a landing-place

Helping the Flier to Find His Way Home

"WHICH way shall I fly?" quotes the optimistic airman. He himself—not his paradise—is lost. His radio compass has gone bad; a heavy fog completely hides all guiding lights on earth. True, the stars shining brightly above help him to find his approximate latitude and longitude, and he knows from his propeller the speed at which he should be flying. But is he drifting off his course, and if so at what rate? He cannot tell. If he tries to land he may crash into a tall building and be killed.

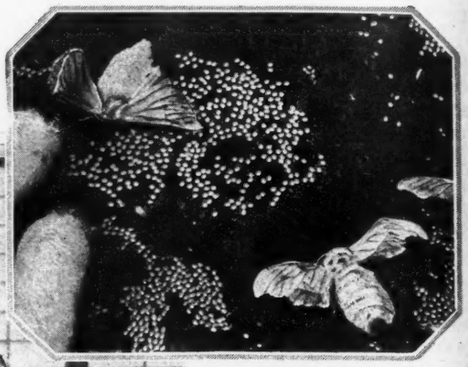
Aerial guiding lighthouses would eliminate to a great extent this danger in flying. Captive balloons, equipped with high-powered search-lights, might be flown from aviation fields and well known landmarks. Lights of different colors attached to the cables near the top would indicate the various names of the places below: for instance, a red light above a blue one might mean the Mineola aviation field; whereas two red lights could mean the Times Building, New York.

Furthermore, it has been suggested that lights be strung down the cables leading to aviation fields. Then, if an aviator spiraled down around these lights, he would be sure of a good landing-place.

King Silkworm

Thousands of Japanese spend their lives in the service of this autocrat

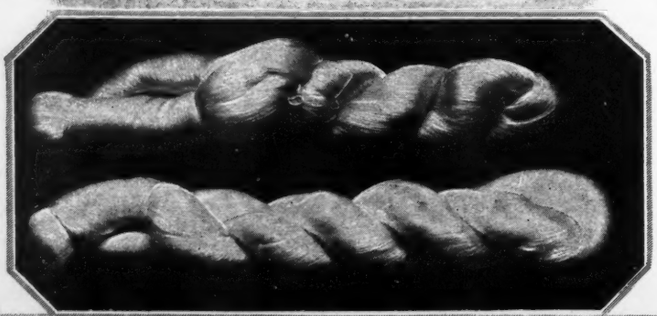
Silkworms ought to be beautiful, but look at them; they are just as ugly as any other worm. The silk industry originated in China; but the Japanese realized its importance to such an extent that in some of their villages every home is a silkworm nursery. The worms are here feeding on the mulberry leaf



Eggs, cocoons, and moths of the silkworm. In winter the eggs are carefully spread out on sheets of paper and placed on trays. When the larvae hatch out, their human attendants chop up mulberry leaves and scatter the pieces over the tiny worms. As they mature each worm receives a whole leaf a day

Japan takes in forty million dollars yearly in her silk industry. The government has established a free school near Kyoto for teaching the business thoroughly

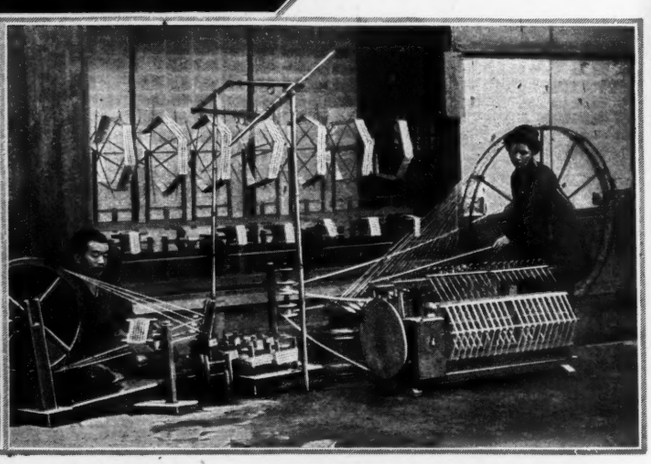
But weaving at home is still carried on to a great extent, as witness this Japanese woman, who is employing a rather primitive method in the weaving of raw silk



Photographs © by Newman Traveltalks and Brown & Dawson

Skeins of the beautiful shiny stuff as it goes to the "silk throwster." Its length is frequently a thousand yards

The thread consists of silk fibers wound together, the separate fiber having been actually spun by the worm



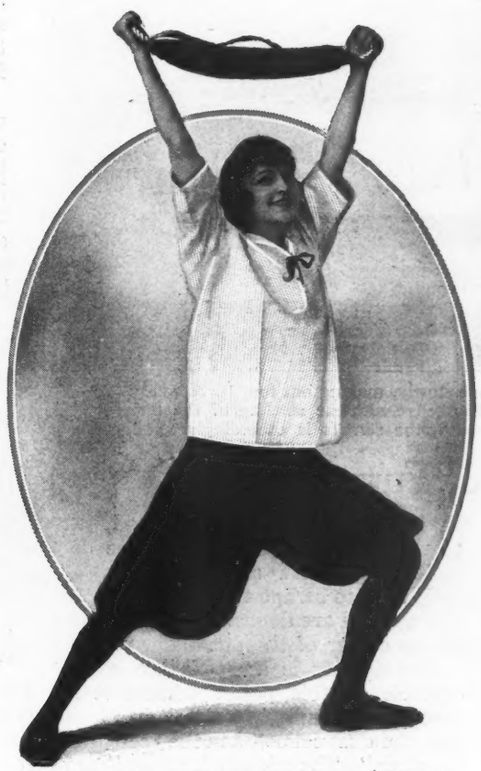
The silkworm is probably the only worm that gets any human help in the pursuit of its business. In spinning cocoons silkworms need plenty of space. Here the kindly Japanese are preparing *aba*, or supports for them to spin on

It is when the cocoon is completed that the ulterior motive of the silkworm-owners appears. The chrysalides in their cocoons are killed in boiling water, and the threads are separated. Then the filaments are unwound and spun for the weaver

Amazons in the Making

It appears to be a happy as well as healthful operation

Ready to dance? Not in those shoes; they are heavily weighted in the toe and are used for exercising the legs. Such shoes are officially known as "pedal dumb-bells"



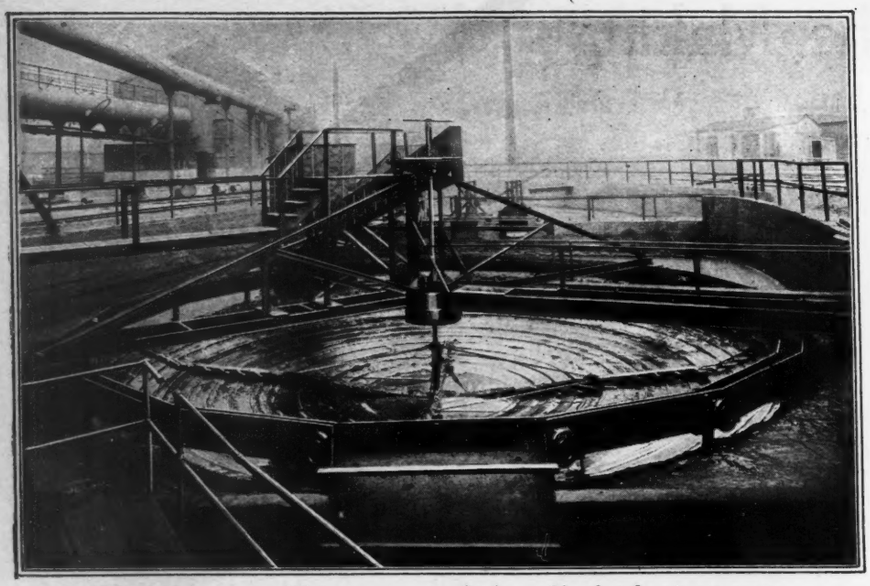
In her hands she holds a sand-bag, thirty inches long and five pounds heavy. When her arms grow tired she will slip her foot into the strap on top of the bag and raise it up and down

Now she treats the sand-bag as if it were a Roman candle—whirling it skyward through the air. The pull she must exert in order to keep it from flying off at a tangent is a good muscle - developer

While her right hand holds the bag on high, She balances by resting her left hand on her hip. In this position she manipulates the bag easily

Though it looks very much like an iron handle, it is really a new kind of dumb-bell. It must be held tightly while in action or it will topple over; for the weight is concentrated in the upper half

Five pounds of sand hanging from her foot disturbs this young woman not at all. She takes to it as easily as if she were going upstairs



The revolving arms of the scraper move slowly, making but four turns every hour, for any rapid movement would interfere with the settling of the fine particles of dust. The power consumed by the scraper is exceedingly small

Scrubbing Iron Out of Furnace Gases

ONE of the by-products of iron-smelting is the gas that is generated in the smelting furnace by the distillation of the coke that supplies the carbon for the deoxidation of the iron ore. The carbon, at the high temperature in the furnace, combines with the oxygen of the iron ore and forms a mixture of gases, one of which, carbon monoxide, is combustible.

These blast-furnace gases escape through the vent of the furnace, and are laden with flue dust, consisting principally of fine particles of iron, manganese, silicic acid, aluminum oxide, lime, and carbon. Before the escaping gas can be used for the heating of boilers it must be purified. First, it is allowed to pass through a "settling chamber," in which most of the larger and heavier particles drop out and collect in pans at the bottom. The finer particles, small enough to pass through a 100-mesh screen, remain in the gas and are removed by "scrubbing"; that is, the gas is washed by passing it through water.

The water that comes from the "scrubber" carries an average of two hundred grains of solids to the gallon, sometimes as much as three hundred and fifty grains. Formerly this dust-laden water was allowed to run as waste into the nearest river or lake.

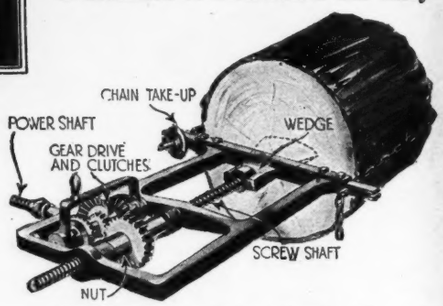
The most improved method of reclaiming the solids in the "scrubbing" water, a method used in many modern plants, consists in conducting the dust-laden water into a shallow, conical pit about forty feet in diameter. A vertical shaft, suspended from a steel framework, reaches down to the bottom of the pit in the center and slowly rotated by a two-horsepower engine. To the lower end of that shaft several arms are attached, to which paddles or scrapers are fastened at such an angle that they tend to scrape the solid particles, which are deposited as mud, to the center of the pit.

The deposit is scraped into a receptacle at this point, whence it is pumped to a tank, in which it is mixed with the dust collected in the "settling-chamber." The mixture is pressed into briquettes, which are smelted with the iron ore.

A Machine for Splitting Logs in Two

IF you wished to break a stick in half, you would probably put your foot on the center of the stick and pull at the ends. Following somewhat the principle of this natural method, Albert Hunter, of Spokane, has invented a machine for splitting logs.

A chain, fastened to one end of a cross-head, is brought down the side of the log to be split, carried across the end and up the other side, and is then fastened to the near end of the cross-head. Jutting through an opening in the cross-head is a wedge blade. The back end of this blade is attached to a threaded bar carrying a pinion wheel which engages a train of gearing. When the gear is revolved the bar moves forward, forcing the blade into the log. When it has gone its full length, the gear is reversed. An ordinary engine is used.



The log to be split is chained to a cross-head, and a wedge blade is forced into it by a gear-driven threaded rod

A Fish and Its Scales Are Soon Parted

HOW do you scale a fish? With a knife, probably; but it took you quite a while to learn how, and the job is at best a messy one. Mr. Harlan A. Perry, of Westboro, Mass., tells us of a better way — by using the fish-scaler which he has recently invented. It looks like a bath-brush and is operated like one; but instead of bristles it is studded with metal spikes. These spikes are flexible enough not to tear the fish's skin off with the scales.

The frame that holds the spikes is made in two sections, spaced a small distance apart. The spikes are inserted in holes in the lower one; their heads keep them from slipping out. But the spikes are constructed to move through the short distance between the lower and the upper frames, which are likewise made of metal.

The novel construction and constant movement of the spikes tend to make them yield in every direction, so that, in addition to removing the scales from the fish, they are also practically self-cleaning.

The young man in the picture is using the scaler on a big fish, but it can be used on small ones as well.

This fish-scaler is built like a bath-brush, but has movable spikes instead of bristles

Under the Ice to the Pole

In a wonderful submarine that feels its way under icebergs with the help of a blind man's stick

By Simon Lake

MR. LAKE *hardly needs an introduction to readers of* POPULAR SCIENCE MONTHLY. *He is a pioneer inventor and builder of submarines, creator of the "even-keel submergence" type of submarine.*

To hear Lake tell of his early struggles is to make one wonder why inventors are regarded as white crows. When Lake, as a young man, would fight his way into the office of a bank president and try to borrow money with which to build a submarine that would run on the bottom of the sea on wheels, the president would think to himself, "Another crazy inventor!" When Lake went so far as to say that he would provide his submarine with a compressed air-chamber out of which a diver could step upon the bottom of the sea without letting in a drop of water, the president would look around uneasily and surreptitiously press a button.

Lake did build that submarine. What is more, it had a compressed-air chamber by means of which divers actually left and entered the submarine under water. Today Lake is one of the foremost submarine builders in the world—an expert who is consulted by most of the great naval powers.—EDITOR.

Simon Lake

WHEN I think of the long, painful struggle with the elements, the hardships, the privation that have attended the discovery of the poles and that still attend polar exploration, I wonder why a scientist deliberately enters the frigid zone with an equipment that has been ridiculously antiquated for at least twenty years. The newspapers speak, very properly, of a "dash" to the pole. A dash it must be if the goal is to be reached during a few favorable weeks over ice and snow.

Must Be Reached by Strategy

The ice-bound region is approached strategically, as if it were a field fortification on a battlefield. Year after year Peary toiled over hummocks and eluded treacherous crevasses. Polar exploration has always meant blinding snow-storms, living on dog's meat, disease, and death.

All this is unnecessary, to my mind. Polar exploration is undertaken primarily for scientific purposes. Yet the very circumstances that attend these "dashes" are against painstaking scientific work. That the poles have actually been reached, that we know a little of polar life, that the general configuration of the earth around the poles has been very roughly sketched, is little short of miraculous when we consider the terrible hardship that has been endured.

All the privation and suffering, all the ice-bound months in the black arctic night, could easily be avoided if the submarine were employed for arctic exploration. Think of Nansen covering three quarters of a mile a day for eighteen months—delayed by open water and slush-ice in summer, and by intense, gnawing cold in winter. Then think of a submarine traveling comfortably, even luxuriously, under the polar sea at the rate of a hundred, perhaps even two hundred miles a day, coming to the surface at will, making its scientific observations in the thorough, leisurely fashion that always characterizes scientific investigation, and bringing back with her after a few months a veritable encyclopedia of information that could hardly be gathered by the ordinary means in decades.

What will the Esquimos say when they see the polar submarine bobbing up from beneath an ice-field?

But is it possible? Arctic explorers think so. Captain Scott Hanson, who was a member of Nansen's expedition, enthusiastically endorsed the plan that I drew up. Latterly Mr. Vilhjalmur Stefansson, one of the most intrepid of arctic explorers, has taken an interest in the possibilities of the submarine.

Let it not be supposed that any underwater craft may set out for the polar seas and boldly plunge under the ice when she can make no further progress on the surface. Only a vessel especially designed to cope with the peculiar conditions that prevail under arctic waters may be safely employed.

The Polar Submarine

At the suggestion of Captain Hanson, I designed a polar submarine that would probably meet the requirements—a vessel that embodies all the knowledge that I have acquired in operating underwater craft under circumstances fully as trying as those that must attend arctic exploration.

Any plan for voyaging to the poles must depend, for its success or failure, on the extent of the ice-covered areas and on the depth of the ice. A submarine cannot travel indefinitely under water. Its storage batteries must be recharged—an operation that is carried out at the surface.

Moreover, the air-supply of the crew is limited. Thirty-six hours is about as long as a submarine may remain under the surface. Hence the area covered by the sea ice must nowhere be so great that the submarine is prevented from coming to the surface within that time. The depth of the sea ice is important, because even the stoutest submarine built for the Navy is not designed to withstand the tremendous crushing strength of the water that prevails below two hundred feet.

Can It Break through the Ice?

Mr. Stefansson assures me that open water is encountered more frequently in the arctic, even in winter, than is commonly supposed. When it is coldest, an arctic explorer finds every twenty-five miles water that is either actually open or that is covered with ice thin enough to be broken by a hammer blow or by strong pressure. It follows that the arctic explorer in his submarine is in no danger of being suffocated because ice prevents him from coming to the surface and renewing his fresh-air supply.

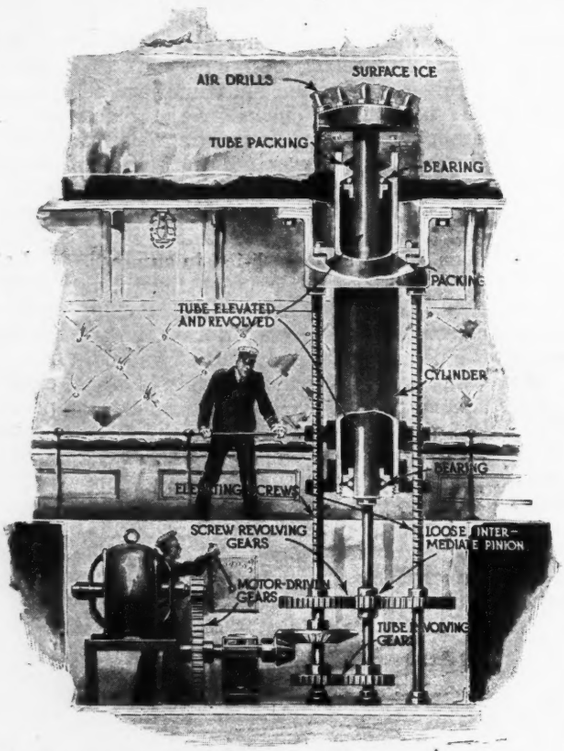
But will not a few inches of ice offer obstacles in rising? I have found from actual experience that a submarine is an excellent ice-breaker. It is easier to lift ice than it is to break it down in the manner pursued by ice-breaking steamers. I have designed a special form of ice-breaking submarine which will be easily able to cope with ice much thicker than the comparatively thin sheets of which Mr. Stefansson has written to me. My submarine, the *Protector*, fitted out in 1903 for experimental navigation under the ice, had an inverted toboggan or a pair of runners built up over the conning-tower. It was easy for her to lift eight inches of ice and to break into open water.

What of the depth of an ice-pack? Wind and wave pile cake on cake, until a huge congealed mass is formed. Does it extend below the critical two hundred feet beyond which submarines of today may not descend lest they be crushed like eggshells? Here again Mr. Stefansson reassures me. It has been his experience, confirmed by Peary, that one hundred and twenty feet is the probable maximum depth of the irregular projections that hang from the comparatively level surface of sea ice. Clearly the margin of safety is ample, when it is considered that two hundred feet is easily attainable by present submarines.

Imagine yourself in a submarine under the arctic ice. Suppose that your craft suddenly strikes a great, pendant, jagged mass of ice. What then? Will not the outer shell be punctured? Clearly, some way must be devised of either seeing or feeling one's way.

Feels Its Way Like a Blind Man

Seeing is out of the question. Even assuming that the polar waters are free from sediment and therefore remarkably clear, it is impossible to see more than forty or fifty feet ahead—a distance so short that a disastrous collision with downwardly hanging ice is inevitable. There is but one solution of the problem. The submarine must feel its way. A blind man taps his way along with a stick; his onward progress is a series of experiments in feeling. An insect has its antennae.



The polar submarine would be provided with an ice-cutter—a tube extending up through the submarine and operating chisels or drills by compressed air

Something like the blind man's stick or the insect's antennae is wanted.

The necessary feeling devices were invented years ago, and tested—not, to be sure, under the ice of the polar seas, but under conditions very similar. My first submarine, the *Argonaut*, could not only swim like a fish, after the fashion of any submarine of today, but also run over the bottom on wheels. When I used her as a kind of under-water automobile, I would regulate her buoyancy so that she would run over even the softest mud without sinking in. Indeed, I found that she would readily mount and glide over a giant rock. Fearing that I might some day run into an under-water cliff or into a sunken ship and smash the lookout windows in the bow, I rebuilt her with an overhanging nose which could be collapsed without admitting water into the main hull. But, what is more to the present purpose, I provided her with the very blind man's stick that must be used if the submarine is to be employed in polar exploration.

The Blind Submarine's "Feeler"

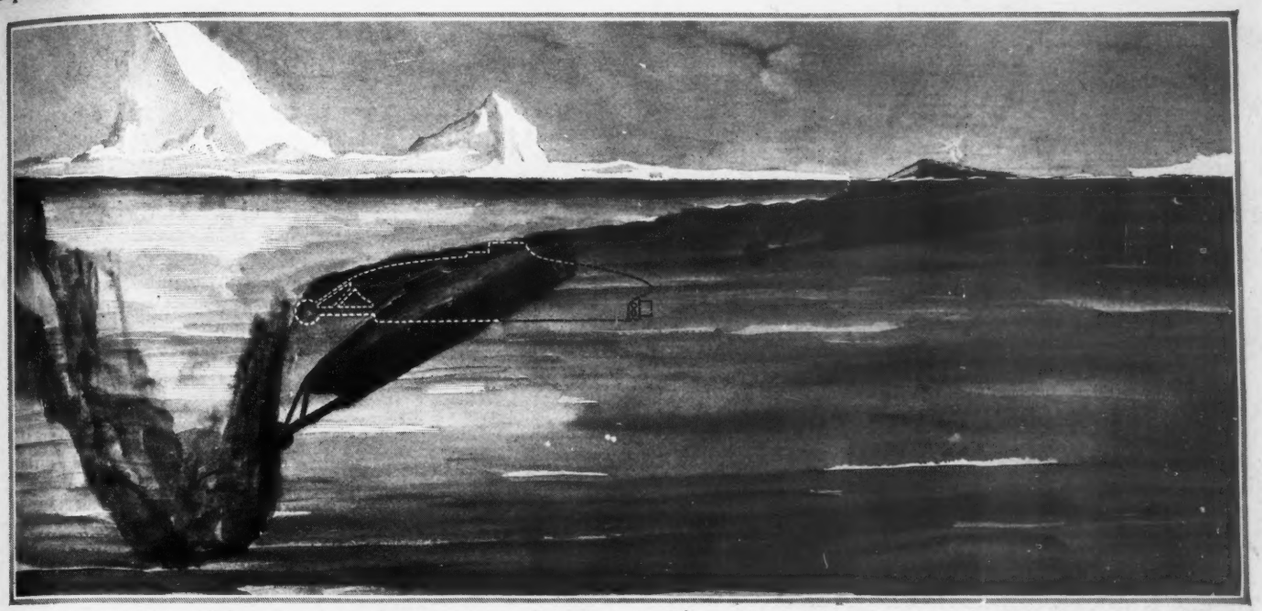
What was this blind man's stick, this "feeler"? Nothing more nor less than a telescoping bowsprit. At the inner end of a heavy six-inch pipe was a plunger that could slide into a cylinder perforated so that the sea-water could enter and leave. The operation is obvious. When the bowsprit collided with a rock the plunger was forced back into the cylinder and the force of the impact expended itself in driving the water out of the cylinder through the perforations. Thus a simple and effective hydraulic cushion was provided.

But, it may be objected, suppose the object encountered was lower than the bowsprit? I provided a "nerve" that met the situation—a steel wire rope that ran from the end of the bowsprit down under the forefoot of the submarine. The bowsprit was held in its extended position by brass plugs screwed through the top walls of the pipe ram and cylinder. When the *Argonaut* was running on wheels over the bottom and the wire touched an obstruction, she would rise, because she was so nearly buoyant, and slide over. If she met an obstruction, head-on, the bowsprit then would shear the brass plugs that held it in position, and slide back, shutting perforation after perforation in the cylinder. Thus the vessel would be brought gradually to rest.

Crawling Under an Iceberg

Here, then, we have the very mechanism that would enable a polar submarine to feel its way beneath pendant ice. I would improve it, however. At the outer end of the bowsprit feeler I would mount a wheel. Thus equipped with a wheeled sprit, the craft could climb the side of a precipice, so long as the propellers were running.

Why this should be possible a naval architect will understand better than a layman. The naval architect will explain to you that the distance between



Two positions of the submarine as it approaches an ice-cake. Her periscope is first lowered. She reduces her buoyancy to a few tons. The wheel and inclined guides at the bow cause her to run under the edge of the ice. She dives under the ice at a slight inclination and comes to a level keel again as soon as she secures a bearing on the reverse toboggan placed just over the center of buoyancy. On the left the submarine is shown charging pack-ice. The guide wheel at the end of the bowsprit, or feeler, which is held in its extended position by compressed air, touches the vertical hanging wall of the iceberg, and it is pushed back into its cylinder to a degree depending on the submarine's mass and velocity. The bow is dipped down, the inclination depending on the weight of the mass, the distance between the centers of gravity and buoyancy, the thrust of the propeller, and the distance between the line of the thrust, center of buoyancy, and center of gravity of the ship

the center of buoyancy and the center of gravity of a submarine is only a few inches. Hence the wheel at the end of the bowsprit is several feet above the center of buoyancy. As soon as the sprit-wheel touches a vertical wall, a back pull is exerted several feet above the center of buoyancy of the vessel. The bow is lifted and the entire hull rotated slightly around the center of buoyancy. It is astonishing how little effort is required to make a submarine lift herself over rocks. In the *Argonaut* we rarely knew when we were mounting obstructions. There was no shock, and only the depth-gages told us what was happening.

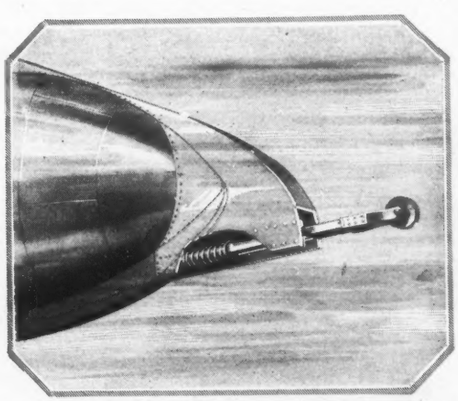
Overcoming Natural Conditions

Once I even "hurdled" a small wreck in the *Argonaut*. In the Gulf of Finland I navigated my wheeled *Protector* over a bottom that was rougher, harder, and more uneven than any ice-pack is likely to be. In a distance of less than one hundred yards I encountered variations of forty and fifty feet in depth.

Since ice hanging down from above is to be avoided, the "feeler" of the *Argonaut* would be reversed. The collapsible bowsprit would project directly from the forefoot, and the wire nerve would be strung from the top of the bow to the axle of the contact wheel. The accompanying illustration of a submarine traveling under an iceberg shows how the worst possible conditions may be readily overcome. Through thick glass ports in the bow and in the conning-tower the condition of the ice as the submarine is sliding under a berg can be noted. I used searchlights on the *Argonaut*, but searchlights would be of little advantage if there were much sediment in the water.

Under the Ice on Wheels

From this account of my experience with the *Argonaut* and of the simple inventions that can be used to grope one's way beneath the polar ice, it becomes apparent what type of submarine I would advocate for arctic exploration. She would be a 500-ton vessel, with a surface speed of about twelve knots and a radius of action at ten knots of about six thousand miles. Her maximum speed submerged would be ten knots. Five knots is a more economical speed; her submerged radius of action would then be about two hundred miles. Her hull must be strong enough to withstand the pressure of the water at a depth of three hundred feet—strength easily attainable when it is considered that a depth of two hundred and eighty-five feet has been reached with United States Navy submarines. She must have the usual hydroplanes and depth-control rudders, and she must have the "feelers" that I have described in order that she may grope her way under the ice. Wheels, too, she should have, so that she can run along the bottom, as I did in the *Argonaut*.



When this telescoping bowsprit collides with a rock, the plunger is forced back into the cylinder, and the force of the impact expends itself in driving the water out through perforations

Out through the Ice

Since such a polar submarine is intended to fulfil a scientific purpose, I would provide her with a compressed-air compartment by means of which a diver can step out on the ocean floor, collect samples of marine life, and return again. The pressure of air within the compartment would keep out the water. The diver would find no more difficulty in stepping out upon the sea and back again than he would in entering or leaving his house by the front door.

Lastly, I would provide an ice-cutter, a simple device consisting of a tube which can be extended up through the submarine and which will serve to operate chisels or drills by compressed air. Through the tube fresh air could be drawn in while the vessel is still under the ice. By means of a larger telescopic tube a hole can be bored through the ice big enough to permit the crew to climb out.

Human animals performing in this cage get all the sensations of a boxing bout

If You Must Fight, Fight a Ball

THE curious-looking structure shown above is the home of a new game invented by Timothy Daly. The cage is about twenty-five feet long, twelve feet wide, and eight feet high. The roof is solid, but the side walls are made of one-inch slats, so there is plenty of fresh air. At each end of the cage are pockets for the balls.

You and your opponent take positions at each end of the enclosure, one of you bounces the ball and gives it a punch in the general direction of the opposing goal, and the game is on. The ball must be kept always in the air after being put in play, and he who first punches it through his opponent's goal scores first blood.

Hollow seaweed stems make very good siphons for bailing out water

To Prevent Damage When the Fly-Paper Flies

IT'S an ill wind that blows curtains into fly-paper and fly-paper to the carpet; for the glue on fly-paper ruins other things almost as completely as it ruins flies. That is why the holder shown in the picture below has been invented. It is a wire frame bent so that a sheet of fly-paper will fit in it snugly. Curtains and carpets will hit the wire instead of the glue.

What is this glue? Resin. And what is resin? It is the yellow gum that you see often on the bark of trees, secreted by the tree through special resin canals. Alcohol will draw this resin prematurely out of most plants, and since a large amount of resin is used commercially, this method is often used. Fresh resin is soft and glue-like; but it will harden gradually when exposed to air.

But when it is used on fly-paper the flies usually fill up every available inch of space before the hardening takes place.

This wire case for fly-paper will protect the curtains and carpets when the wind blows; but of course it won't help much if you should sit on it

Let Seaweed Bail the Boat

ON the beaches along the coast of Maine, where the tide rises much higher than on parts of the coast farther south, great quantities of a heavy brown seaweed, commonly known as "kelp," are washed ashore.

Some of the long stems of this seaweed are hollow and tough. This fact is well known to the small boy on the Maine coast, and he has discovered that the stem can be used as a siphon. After a storm in which the fishermen's dories on shore have been filled with rain or flying spray from the surf, it is the job of the small boy to bail out the boat.

First he collects a lot of long kelp stems, and after draping them over the side of the water-filled craft, sets them all working as siphons by the primitive method of sucking on the outboard ends of the stems until he gets a flow of water running through each.

He's a Champion Preserver

ELMHURST, on Long Island, New York, a town rich in farm-land, had a canning contest. The contestants, composed of three hundred women and a few men, grew all the vegetables that they put in the cans which were entered in the contest. Who won? One of the men! His name is Charles Rundquist, and he is shown herewith surrounded by many of the vanquished cans of his rivals.

Virtually none of these vegetable-growers knew anything about farming before the days when the national cry became food conservation. They did all their planting and growing in war gardens, and found it so profitable that they have decided to keep it up. In fact, Mr. Rundquist and many of the others live in apartment-houses and do their farming on fifty-by-twenty-foot plots a short distance away.

Here is a man who beat three hundred women! Don't be alarmed; it was only in a canning contest

Don't Lose Your Head or Your Hat

ANYONE who has, in a high wind and a high temper, pursued his errant headgear down the street will be interested in a new hat-fastening device.

All you have to do, with a hat of any ordinary, common-sense construction, is to insert in the sweat-band at the front or the sides of the hat a light metal plate conforming to the shape of the hat and having a comb hinged to it at a variable angle, making it easy to slip into the hair. Fastened to each end of this plate, again at diametrically opposite points in the back of the hat, and passing through a barrette, is an elastic band which may be easily concealed. Insert the comb in the hair, gently pull the hat down to a comfortable position, arrange the barrette—and there you are, ready for any old gale that blows.

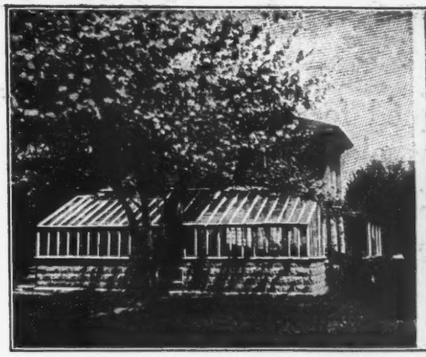
Or, if you prefer, dispense with the barrette and use any number of these special combs elastically secured at any desired point in the hat.

A simple, comfortable, and inconspicuous device for keeping your hat on

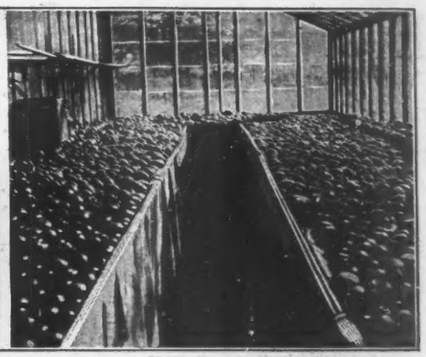
Why They Weren't Working

IT was not a bank holiday, so why weren't the Rolls-Royce people working? This question was heard in Derby, England, on June 16 last. The answer came, proudly, from the workers themselves that they were having an extra holiday to celebrate the first non-stop transatlantic flight. And why were they specially interested? Because they had made the two engines that safely propelled the Vimy Vickers airplane on its big trip.

The flight was made in fifteen hours and fifty-seven minutes, with an average speed of 117½ miles an hour.



If you have a greenhouse you can ripen your vegetables and fruits indoors when cool weather comes



These tomatoes were perfectly green when they were taken to the hothouse, but they will come out red and ripe

Off to the Hothouse

IF there are green tomatoes growing in your garden when autumn comes, pick them and put them in the greenhouse. They will ripen in a few days. That is the advice which Mr. A. J. Copelin, of Chicago, gives; and, judging from the number of tomatoes in his greenhouse, he ought to know. In picking them he left at least half an inch of stem to prevent rotting.

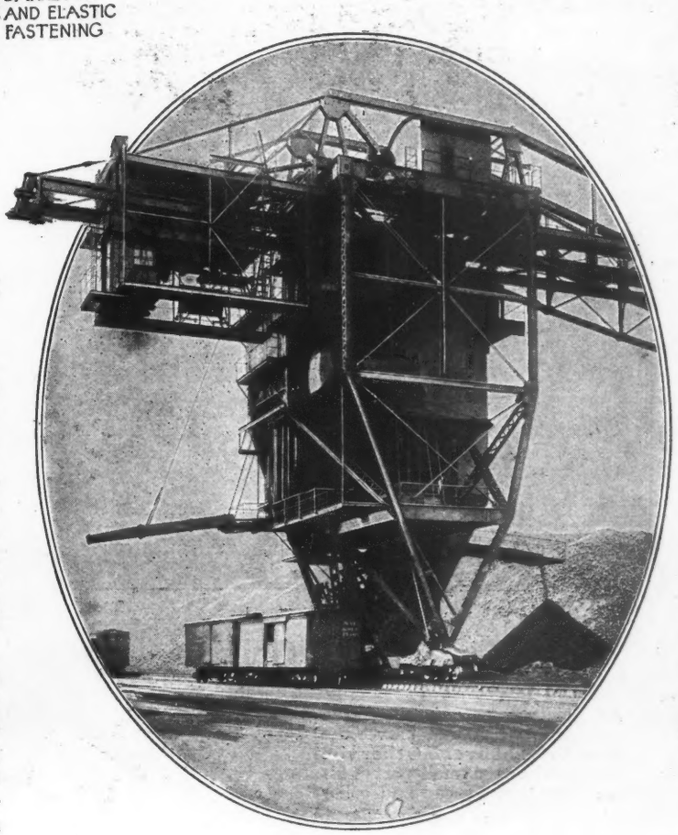
He picked the largest tomatoes first, and by the time they had ripened the next lot had grown into their shoes. He kept picking tomatoes until the frost came.

Then he gathered up the vines themselves, brought them in, and planted them in the ground beneath the hothouse. And still the tomatoes grew; in fact, they kept it up far into the winter.

Getting Ore from Mine to Furnace

AT the present time approximately seventy million tons of ore are mined and fed by gravity into the great fleet of vessels at Duluth that carry the ore around the lakes, through the locks, and on to the blast-furnaces.

Modern efficiency demands that vessels carrying this ore shall unload within a few hours, so that a quick return trip may be made. To accomplish this great speed in unloading and loading, large traveling bridges are erected at the docks, permitting grab buckets of fifteen tons capacity to enter the hold of the vessel, fill themselves automatically, and deposit the ore on docks or cars.



One end of a large traveling bridge that loads and unloads vessels for carrying ore

These unloading bridges are gigantic structures several hundred feet in length. To move them, wheels having maximum bearing power are required. Chilled iron wheels are best fitted, because the chilled metal has no malleability and does not flatten or distort under loads of two hundred thousand or three hundred thousand pounds per wheel. The highest concentrated load on wheels in railway service is about thirty thousand pounds. Concentration as high as one hundred and twenty thousand pounds per wheel are entirely permissible; in fact, the limit of load is the point where the chilled iron wheel forms a depression in the rail.

Everybody's Wearing 'Em

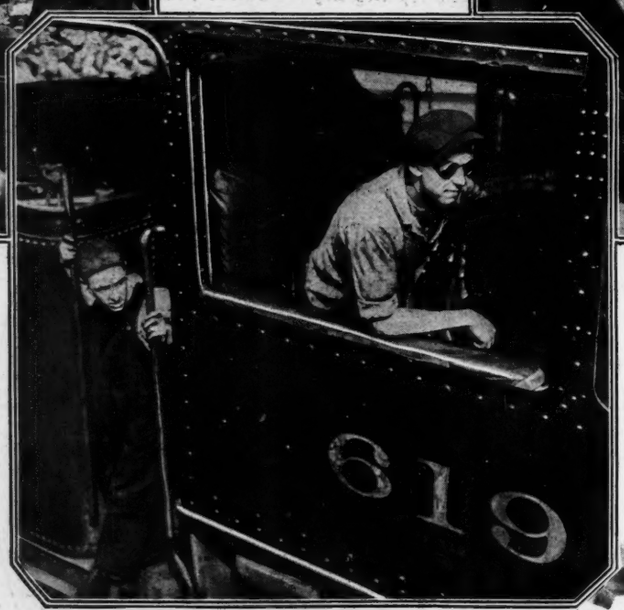
Goggles were not designed for the use of the motorist alone

"Let them kick up the dust, what care I?" says horse No. 3, for he is wearing goggles. Thus he will be able to see his way clear past the horses ahead

According to this strange man, water in the eyes is worse than water in the ears; he protects his eyes with goggles, while he allows his ears to stand out beneath his diving-cap

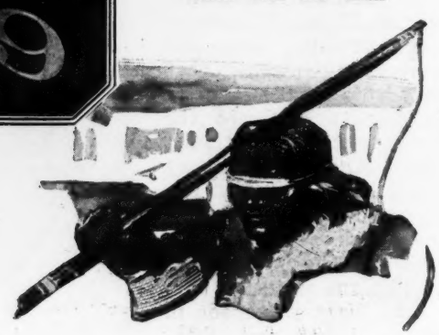
Locomotive engineers as well as automobile drivers have become goggle-eyed because of wind and dust

Goggles likewise ward off the heat that rises when electric riveting takes place



Even the Eskimo is learning that it is no longer necessary to bind his eyes in order to protect them from the glare of the sun on ice and snow; he finds that goggles of colored glass are much better. Of course the white explorer had to teach him the trick

An aviator's nose is about the only part of him that braves the elements above. Otherwise goggles cover the small part of his face left bare by cap and collar



What's a Billion, Anyway?

It's not easy to comprehend, but these pictures may help you

We often hear and see the word, especially now, when we read in the newspapers that the World War will cost something like two hundred billions of dollars; that Germany's indemnity is twenty billions. For the financier the word has a definite meaning. To him a billion dollars represents just so much purchasing power; he knows just how much effort is required to collect it. But what does a billion mean to you? Well, take the Brooklyn Bridge—one of the engineering wonders of the world—as a basis of comparison. Thirteen long years were required to build it. Thousands of lives went into its making. It cost twenty-one million dollars. Yet with a billion dollars we would have sufficient to build forty-eight Brooklyn Bridges

Here's another way of comprehending a billion. Suppose that in the summer of 1870 a paying teller had started counting out one-dollar bills. Counting at the rate of a hundred and fifty a minute, and working eight hours a day, three hundred days a year, allowing for Sundays, holidays, and a short vacation, he would have handed out his last bill in the summer of 1916. It's lucky we don't own a billion. Think how many people we should have to employ to keep it counted

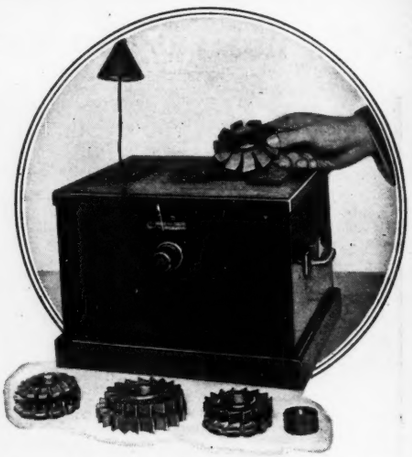
Taking the Magnetism Out of Tools

IN making cutters, gages, files, and all small tools, magnetized iron is never used. When these tools are held in magnetic chucks for any length of time, however, they nearly always become slightly magnetized. The result is that they gather unto themselves many small chips of steel and iron, and lose their keenness and sometimes even break.

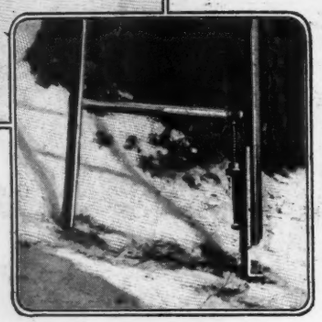
The remedy for this is a tool-demagnetizer. One is shown here. A cutter is being demagnetized. The workman holds the cutter over the three powerful poles of the machine, which pull the molecules of steel in the cutter out of their regular magnetized order.

The theory of magnetism is this: every molecule of iron or steel possesses a positive and a negative pole. If all of these molecules in an iron bar are arranged so that their positive poles point in the same direction, and consequently their negatives do likewise, the bar becomes a magnet. But when the molecules are in no regular order magnetism is not evident.

A certain amount of magnetism exists in all iron and steel. But iron and steel enter the magnet class only when their magnetic powers are great enough actually to draw up less powerful pieces.



By holding the cutter, which has accidentally become charged, over three powerful magnetic poles, the workman demagnetizes it



An extension foot that holds fast is a better ladder support than is the unreliable brickbat

A Good Ladder Foot Saves Legs

"THE inventive idea," says the inventor of this ladder attachment, "was the application of a positive adjustable member to a ladder leg. A screw was the best adaptable device that I could think of, and so I concentrated upon the application of a lifting-jack to a ladder."

The sliding attachment for the leg is controlled by a thumb-nut of sufficient length to allow for the required adjustment. Teeth that bite into the supporting surface are located at the bottom or foot portion of the attachment and prevent slipping. On the other leg of the ladder is another foot-plate, also provided with teeth, but this support is fixed instead of being adjustable.

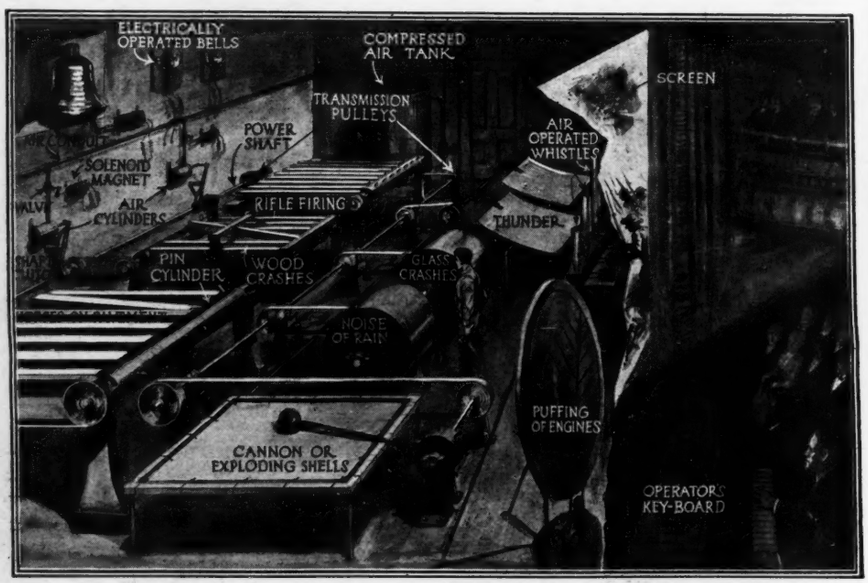
The movable foot slides in a suitable guide-way, which insures the needed adjustment with the least possible lost motion and wabbling. Not only can the device be attached to ladders, but it can be used in connection with scaffoldings. The painter and the builder often have difficulty in securing a good foothold for their scaffolding, for the brickbat so often resorted to has never proved very reliable. The device described would therefore seem to have a widely extended field for usefulness.

The weight is but slightly over five pounds, and the only tool needed for attaching is a screwdriver.

New Thrills in the Movies

LET us suppose we are witnessing a photo-play of the war. A locomotive puffs into a station behind the lines, whistle shrieking, bell ringing. Soldiers alight and march away, their hob-nailed shoes clumping on the cobbles. From the distance comes the deep-toned reverberation of cannon.

All these noises, and more, are produced by a machine invented by Frank Illo, of Dallas, Texas, Briefly, the machine is an assembly of many sound-producing instruments unified through a central electrical control; more specifically, a series of shafts, belts, and pulleys, diaphragms covered with buckskin, revolving cylinders partly filled with water or with lead shot or steel balls, wooden beams and slats, flexible sheets of tin or other metal, air-valves, whistles, bells, etc., to be used at the will of the operator.



Here's the machine that reproduces dramatic sounds called for in the action of a play, from echoing thunder to the fateful ringing of a doorbell

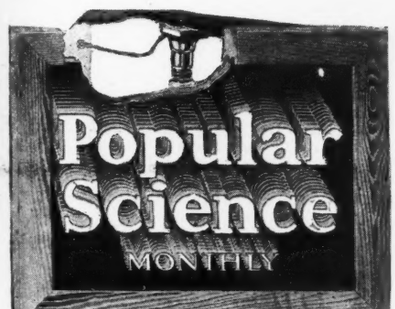
A Modern Magic Mirror

AS it stands on the store counter the mirror shown below looks like any other face-reflecting glass. But as you approach to adjust your tie your features suddenly fade out, giving place to a many-colored electrically lighted sign.

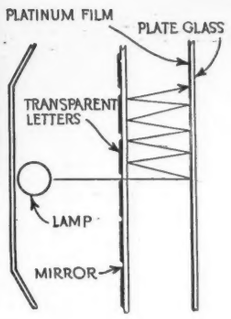
You begin to read, and have just about mastered the message when its words vanish and you find yourself staring into your own startled eyes in a looking-glass as strange as the one that was Alice's gate to Wonderland.

The front of the sign is a platinum-plated, translucent mirror. An inch or so behind it is a pane of glass on which beautiful colors—usually carrying an advertisement—are etched. Behind both there is an electric lamp, backed by metal reflectors. When the light is not turned on the mirror alone shows up. But when the light flashes, the advertisement glows through the mirror in an unusual, many times repeated effect.

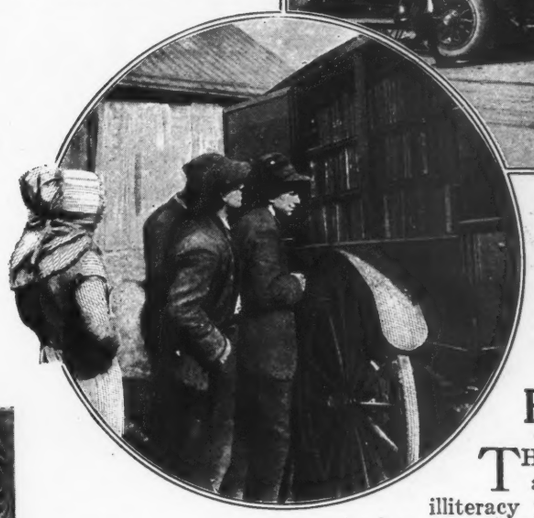
An automatic flasher causes the light to flash on and off continually.



You're looking at this advertisement when, presto! it turns into a mirror; then it suddenly changes back again. It is really nothing more than two surfaces of glass spaced apart with a gasket, behind which there is an automatic on-and-off light



In many cities conveyances take crippled children to school, that their education may not be neglected



By sending wagon libraries to out-of-the-way towns our educational bureaus are gradually bringing up the literacy average

For Better Education

THE honors for literacy must, alas! go to Germany, where the illiteracy percentage is far less than one. England follows close behind. But in the United States nearly six per cent of the people can neither read nor write our language. This sounds bad, but it really isn't when you consider our heavy immigration.

Educational bureaus throughout the country are constantly bettering conditions; for greater literacy means greater labor production. In many counties traveling libraries are sent out—wagons fitted up with book-shelves.

But careful education of the children is the most important branch of all; and so many cities provide conveyances for crippled children to go to school in.

When we consider that India and Egypt are over ninety-two per cent illiterate, our fast decreasing six looks very small.

The Brick that Is Earthquake-Proof

SIR ISAAC NEWTON may or may not have discovered the laws of gravity because of an apple that fell on his head; but we may be sure that Charles H. Brisbin invented an earthquake-proof brick because a brick fell on his head during the great San Francisco earthquake. He told us so himself.

One side of the Brisbin brick has two ring-shaped bosses, while the opposite side has two ring-shaped depressions opposite the bosses. When laid in a wall the bosses fit into the depressions, locking the bricks together, either lengthwise or crosswise.

The Brisbin brick is of the same size as the ordinary building brick, differing only in that one side of it is concaved and the other convexed. This feature makes it absolutely self-bonding and interlocking. After a wall of such bricks has been built no brick can be removed unless all the bricks above it are taken out or a chisel is used.

The interlocking brick promises to be particularly suitable for hollow walls, since it can be used as an absolute bond reaching from one wall into the other, tying course to course in an earthquake-proof structure.

He is building a chimney out of the earthquake-proof bricks which he has invented

In the building of chimneys the interlocking brick is again choice material, since it can be used as a binder to avoid cracks, which have in the past been the cause of countless fires.

The new brick has a great many advantages. It can be laid more easily and quickly and with less mortar. No wires, nails, or broken bricks need be used in connection with it.

Since the brick is concaved, the heat in the kiln reaches the center of the mass of clay more quickly and the burning is accomplished in less time than by the old method.

Several large brick-manufacturing plants in California and Arizona have already equipped their machinery with dies for making self-bonding bricks.

Making Crystals Speak

Not alone do crystals speak in this new science, but phonographs are operated and gun explosions measured

By Lloyd E. Darling

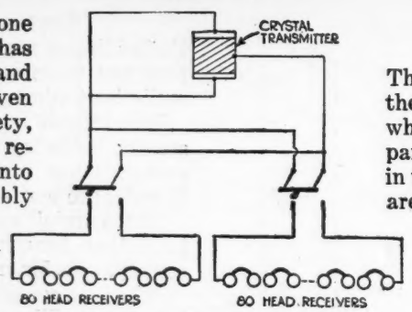
Listening to phonograph music—rendered by a crystal-reproducer in another room, out of hearing

AS a producer of electricity, at least one of the old-timers—the crystal—has been brought out of the museum and laboratory class. In a lecture recently given before the New York Electrical Society, Mr. A. M. Nicolson disclosed some remarkable studies he had just made into the properties of certain crystals, notably Rochelle salts.

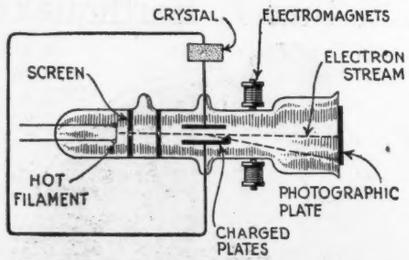
Curiously enough, these crystals, when subjected to a pressure of several pounds and agitated, are quite capable of furnishing an electromotive force of as much as eight volts, enough to operate an indefinite number of telephone receivers in series. If a vacuum-tube amplifier is inserted in the circuit, naturally many more receivers can be controlled. Mr. Nicolson uses this "piezo-electric" effect for an uncommon kind of telephone.

Going out of the room, and talking in close proximity to one of his crystals connected to telephone receivers at the ears of his listeners in the manner shown in the diagram, he is able to make his speech plainly heard. No battery is necessary. The sound waves striking the crystal agitate it sufficiently to produce the necessary currents.

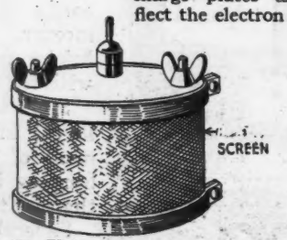
Conversely, if a telephone transmitter and a crystal are connected as shown at the top of the opposite page, the crystal will reproduce whatever is said in the transmitter.



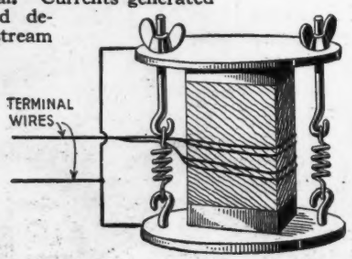
Circuit for illustration above. The crystal is its own battery. In its ride over a record currents are heard in receivers



How Sir J. J. Thomson uses crystals to record explosion effects. Explosion (not shown) jars crystal. Currents generated charge plates and deflect the electron stream



The crystal arranged to act as a loud speaker. The paper screen acts as a diaphragm, vibrating the air

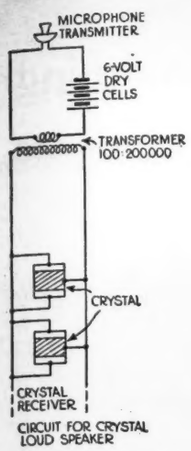


Showing the method of affixing terminal wires. The center of the crystal is of one polarity; the ends, the opposite

The transmitter may even be taken out of the circuit and another crystal substituted, whereupon the arrangement will work, particularly if a vacuum tube be inserted in the circuit as an amplifier. If two crystals are near each other and electrically connected through an amplifying tube, a slight jar will start one to sending currents to the other. This will cause the other to give off a sound; the sound will, of course, agitate the first crystal more, and increase the effect. Presently both crystals will be making noises at each other. A curious "talking together" effect results. It is analogous to the whistling sound sometimes obtainable by holding an ordinary telephone receiver adjacent to a telephone transmitter, the interactions being the same.

If a needle be inserted in one of the compression plates of a crystal and allowed to ride over a phonograph record after the manner of an ordinary reproducer, the selection on the record may be made audible in telephone receivers with great fidelity — all this without all the customary diaphragms of reproducers, or the batteries ordinarily found in telephone circuits.

That certain crystals, when compressed, would become electrified has been known for many years.



Because electric currents will cause a Rochelle-salt crystal to vibrate, it will "speak" when addressed through the microphone

"Piezo-electric effect" is the term usually applied to this phenomenon. "Piezo" comes from the Greek *piezein*, meaning "to press." The "pyro-electricity" of the ancients, though derived primarily from heating, was of this general nature. Mr. Nicolson's work consists in getting somewhere near practical out of this old phenomenon. And surely he has succeeded.

The investigator clamps his crystals between aluminum disks in the manner made clear in the illustrations. Pressure is applied by means of the thumbscrews. During this process electricity is given off, the voltage rising as the pressure increases. Thereafter, if the crystal and its framework be agitated in any manner, as by the tick of a watch, or by a voice, or by anything whatever, a potential will appear between the electrical poles of the crystal, the potential being dependent upon the pressure under which the crystal is operating, the ticks of the watch or a similar sound producing the potential at every tick. Eight volts is a common potential so obtained.

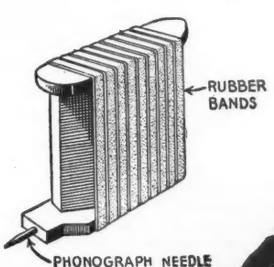
Torsional or twisting forces, applied to the crystal while under compression, also produce the potential. Left-hand torsion, for instance, causes the aluminum disks at the ends of the crystal to take on a negative charge, while a strip of tinfoil, or girdle, held in place with rubber bands around the middle part, takes on a positive charge. In practice about two kilograms per square centimeter of a crystal's cross-sectional area are applied lengthwise of a crystal by tightening up the springs holding the aluminum disks shown in the illustration. This pressure is, roughly, twenty-eight or twenty-nine pounds per square inch, and seems to give maximum variation of the piezo potential. Ten kilograms per square centimeter (about one hundred and forty pounds per square inch) causes the saturation point to be reached.

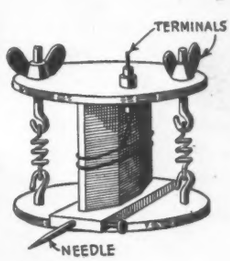
A. M. Nicolson and the Rochelle-salt crystals. The large one weighs over two pounds. In his fingers is a seed crystal. Properly treated, it, too, will grow large

Mr. Nicolson grows these crystals out of jars full of saturated solution of the salts, starting with a small crystal as a "seed." That is, if one takes a small crystal of Rochelle salts, or almost any other salt for that matter, and places it in a saturated solution of the same substance, leaving it undisturbed for hours or days, the small crystal will grow into one infinitely larger. One of the illustrations herewith shows the investigator with one of the hugest crystals he has grown in this manner. This one weighs over two pounds. Mr. Nicolson's work has been productive of much that is interesting.

Sir J. J. Thomson recently announced before the Royal Institution in England investigations of somewhat similar character. But, instead of having experimented so much with telephonic applications, he suggests that a good method to get practical service from piezo-electrics would be to use the crystals to measure instantaneous pressures in the explosion-chambers of guns, gas engines, and similar appliances. Knowing exactly what goes on within a gun or a gas engine makes possible designing them for maximum efficiency, a highly desirable end and not always obtainable at present because of the limitations of existing measuring appliances.

According to Thomson's plans, a tourmaline crystal, properly encased, would be exposed to the explosive pressures to be measured. A suitable small pocket at one side of the explosion chamber might make this possible, or in the case of guns the barrel might be prolonged, and the extension utilized for the mounting of the apparatus in an effective way. Owing to the fact that the voltage given off by tourmaline is directly proportional to the pressure to which it is subjected, and that the voltage almost instantaneously responds to this pressure, in the opinion of Sir Joseph, a crystal would be an excellent medium for measuring explosions of 1/30,000 to 1/50,000 of a second in duration, such as frequently occur in guns and gas engines.





Showing two methods of making crystal-reproducers for phonographs. At the left, rubber bands provide compression; at the right, springs do it

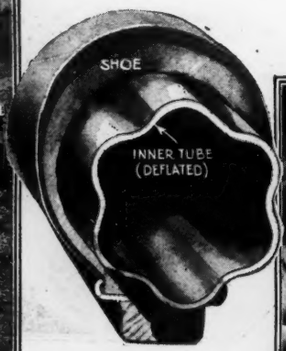
Listening close at hand to a crystal-reproducer. Naturally, the customary phonograph horn is not necessary

Under this plan, the apparatus would be connected as shown in the figure near the bottom of page 54. A hot filament gives off an electron stream in vacuo, a suitable screen holding back all but a narrow beam of electrons. This beam passes between two metal plates capable of being charged by potentials resulting from pressures applied to the crystal during explosions. These potentials are naturally directly proportional to the degree of pressure the explosion inflicts on the crystal, and the electron stream will therefore be deflected by the charged plates in an exactly corresponding amount, registering on the photographic plate because an intervening barium platino-cyanide coating or such, makes its path luminous.

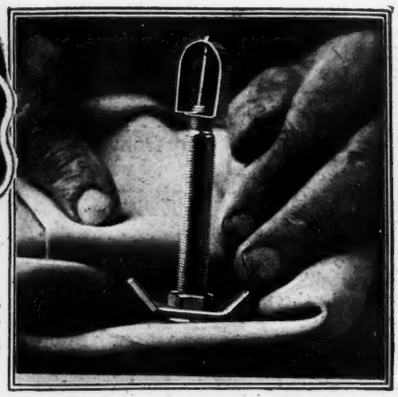
There's Always Something

Attachments designed to promote

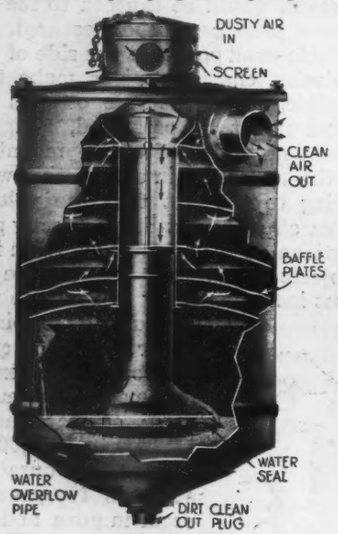
A truck with a water-tight body and special suction pump, used for cleaning sewers and carrying away refuse, is here shown pumping fresh pond water to a water-tank



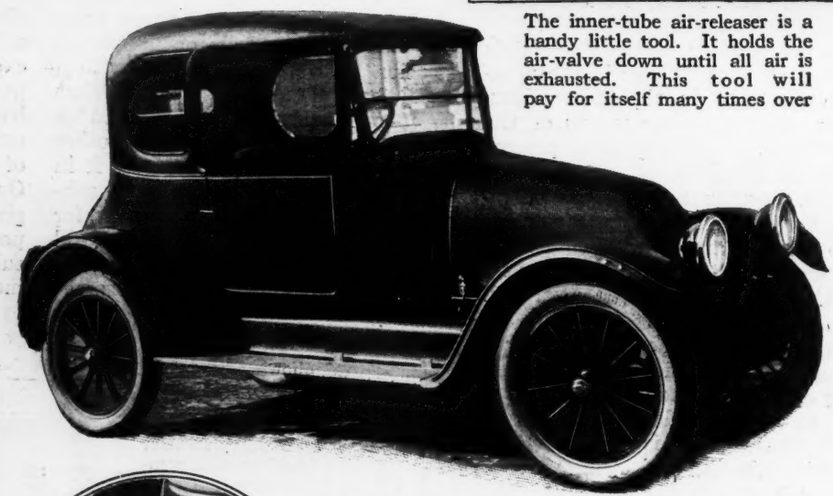
This tube is said to eliminate punctures. Under compression it closes when the nail is withdrawn



The inner-tube air-releaser is a handy little tool. It holds the air-valve down until all air is exhausted. This tool will pay for itself many times over



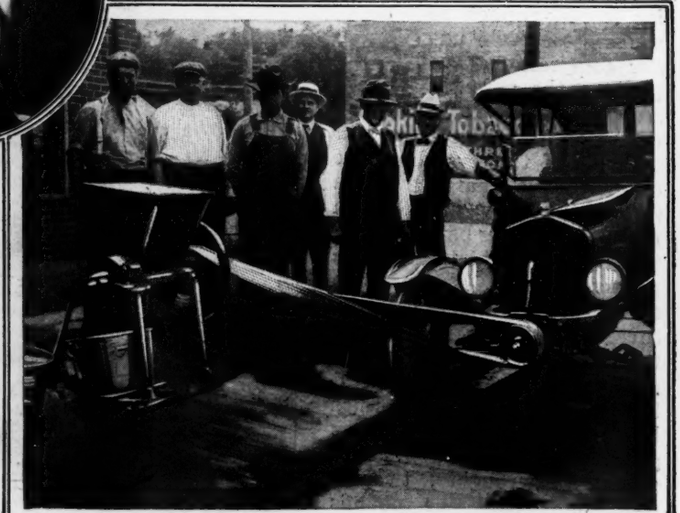
The water-seal air-cleaner allows only clean air to enter the carburetor



From coast to coast cars are appearing covered entirely with leather. It eliminates body rattles, and gives a unique though attractive and lasting finish

The horn button is used the same as a thimble, being kept on the first finger; to blow the horn pressure is applied with the thumb

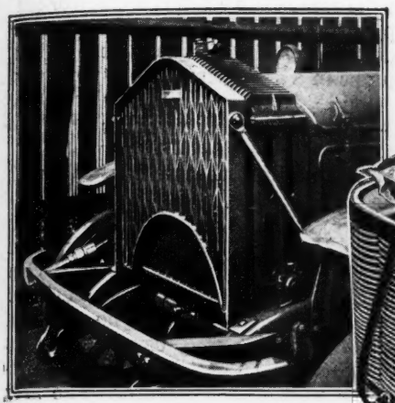
Now comes the automatic socket wrench, which reduces to a minimum the time for removing and replacing engine bolts. It can be operated from any position



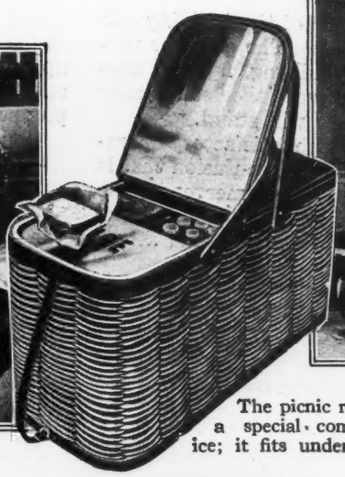
Quickly attached and detached is the power-transmitting contrivance that turns the car into a veritable jack-of-all-trades. It can be belted to almost any machine

New to Help the Motorist

automobile safety and economy

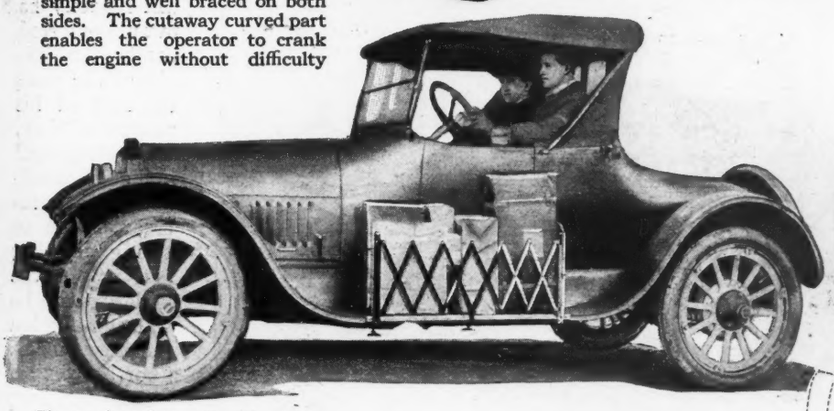


This truck radiator guard is simple and well braced on both sides. The cutaway curved part enables the operator to crank the engine without difficulty

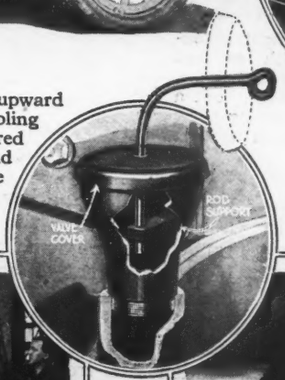


The picnic refrigerator has a special compartment for ice; it fits under the robe-rail

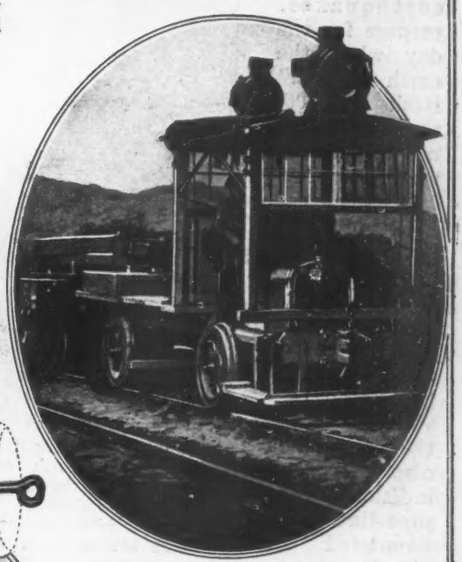
The body is elevated and the ice is thrown into the freight-car refrigerator



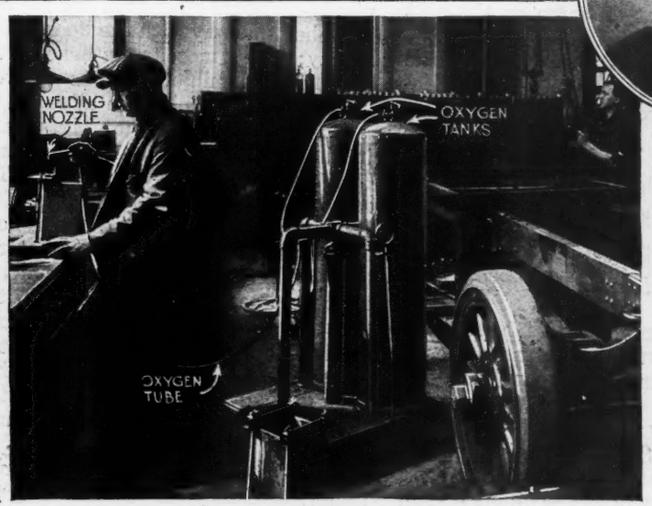
Clamped to the under side of the running-board, this luggage-carrier provides ample space for touring accessories. When not in use, it is folded under the seat



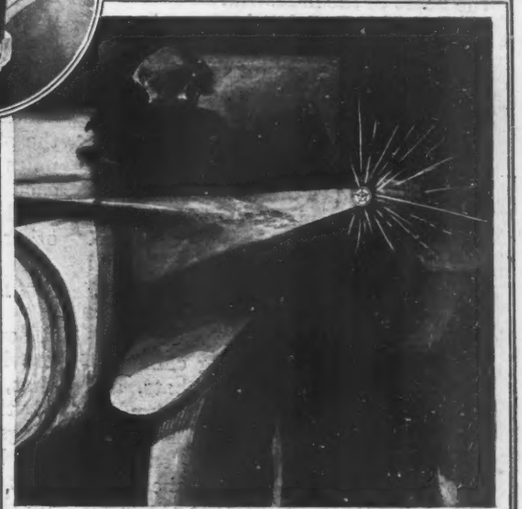
The breather-cap slides upward on a bent pin, thus enabling the oil to be easily poured into the crank-case and also preventing the cap from being lost



This camouflaged motor-truck hauls light trains up heavy grades whenever locomotives are unavailable



Where much oxyacetylene welding is done, the small wheeled stand, with its upright sections of pipe and elbows, enables four oxygen-tanks to be moved about with ease



A patent mirror, worn on the back of the hand at night, reflects the light from the car behind and renders the operator's signal easy to see

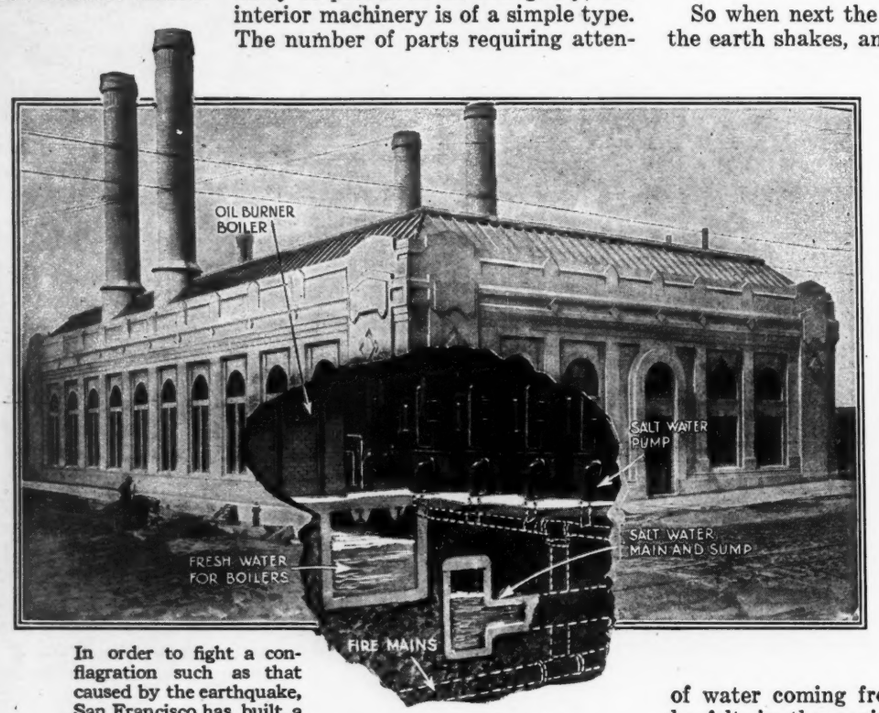
Getting Ready for the Next Earthquake

Profiting by her terrible experience of 1906, San Francisco intends to be fully prepared

By Lloyd E. Darling

SAN FRANCISCO thinks it has one aspect of earthquakes largely settled now. A short time ago the city completed a huge "four-stacker" pumping plant capable of delivering twelve thousand gallons of water per minute into the fire mains, and that at only a few minutes' notice. The plant is there to put out earthquake fires.

"In time of peace, prepare for war," says San Francisco. "In time of no earthquakes, prepare for the day when the earth shakes." Back in 1906, three hundred million dollars' worth of property was burned in a few days because an earthquake shook down buildings and started fires. A large part of that loss might have been prevented had not the earthquake also succeeded in disjointing the pipe-line that connected the city's water reservoirs with the fire mains. So now the city has built this new pumping plant down in the heart of the industrial and old fire-swept district, so that in case of need it will be there to transact an immense amount of business in a short time.



In order to fight a conflagration such as that caused by the earthquake, San Francisco has built a great new pumping plant in her business district

The Plant Is Earthquake-Proof

You may think that an earthquake that shakes down buildings may shake down the pumping plant too, and thereby reduce the whole idea to zero. Not so. This building is of steel frame and reinforced concrete construction, absolutely fireproof, and the roof is so substantial that it can withstand the impact of falling chimneys, cornices of buildings, brickbats, and anything else that the surrounding neighborhood finds it advisable to deposit thereon while the earth is quaking. Steel shutters may be pulled down over the windows if the bombardment is too heavy. All through the walls and interior of the building run struts and braces. The engineer who laid out this building figured that although the heavens themselves may fall his structure will stand.

In order to secure satisfactory operation in the hurry and confusion that is likely to prevail in an emergency, the interior machinery is of a simple type. The number of parts requiring attention or adjustment has been reduced to a minimum, and the design and arrangement are such as to render it improbable that an error on the part of an operator will necessitate the shutting down of any considerable portion of the station. Two independent cast-iron discharge-pipes from the station to the city's seventy-two miles of water mains are laid, one on each side of the building, so that an accident to one will not involve the other.

Not Dependent on One Pumping Unit

Several pumping units have been provided rather than one large one, so that, if anything goes wrong with one of these, all the plant's pumping "eggs," so to speak, will not be in one basket. Steam is maintained in part of the boilers at all times, ready for the emergency. The piping is such that live steam from these boilers may warm the others up in a hurry, while at the same time a fire is being worked up on their grates. Maximum steam output may thus be delivered to the pumps in a short time.

When Next the Heavens Fall

So when next the heavens fall, and the earth shakes, and buildings shudder and totter and collapse in San Francisco's streets, business will be done as usual in this particular structure. The fires under the boilers will speedily be put under forced draft, the engineer will start the first of his pumps to "chug, chug, chugging," and as his available steam increases, due to the exceeding activity in the boiler-room, he will commission the other pumps. Shortly the big pulsating throbs of water coming from this plant will be felt in the mains throughout the city, ready to argue with fires.

There will be no need to go to railroad tracks somewhere about and get fuel, for five concrete tanks at one side of the plant contain enough fuel-oil to operate the boilers at full capacity for ninety-six hours (four days and nights). It is the same way with the boiler water supply; for six more tanks beneath the floor hold a million gallons of fresh water, ready for quick use at any time.

The water that the big pumps in the engine-room of the plant send into the mains, however, is salt. The reason for this is that San Francisco Bay is handy, and, as everybody knows, there is plenty of salt water in the ocean. A reinforced concrete tunnel comes up from the bay, terminating in a sump under the pumps, as seen in the drawing. If the operators have to stay in the plant any length of time during an emergency, there is a kitchen provided, so that they may cook their meals.

All these conveniences make for maximum efficiency in times of great emergency.

No Packing or Gaskets on These Cast-Iron Pipe Joints

MOST cast-iron pipes used to carry water, gas, sewerage, exhaust steam, or dye and acid by-products have joints that have to be securely closed or fitted by means of packing, gaskets, or a poured lead compound. The labor expended in making these joints air- or fluid-tight is the most expensive part of the work, and has led engineers to devise a type of universal pipe and joint which does not require the use of packing, gaskets, or lead to make the joints. All that is necessary are two wrenches, white-lead paste, bolts, and nuts.

The joint is iron-to-iron, only white or red lead being used to make it up. There are bulbous rings at each end of each pipe length, together with two or more ear lugs cast integrally with the pipe proper. The adjacent ends of the pipe being made up fit into each other on a machine-tapered end of about two degrees on the spigot end and about two and one half degrees on the hub end. The ear lugs at each end of the pipe are lined up and bolts inserted through them to draw up the ends of the pipe.

The pipes are laid end to end, and the bolts inserted in the lugs with their heads pointing oppositely; the bolts are then tightened

The molten metal compound is bailed out of the large kettles by means of ladles and is poured into the molds; several kinds are shown below

During the operation of combining the component metals in the melting-kettle, the molten mass must be thoroughly stirred and freed from the oxide scum that rises to the top of the hot metal

The Tinsmith's Glue and How It Is Made

WHAT glue, nails, brads, and screws are to the cabinetmaker, the joiner, carpenter, and woodworker, solder is to the tinsmith, the canner, and the scores of other kinds of metal-workers. Just think of the millions of tin cans and other metal containers that are manufactured every year and that are used for the air-tight packing of preserved foods; the square miles of tin roofs; the hundreds of miles of eaves and gutter-spouts; the countless tanks, kettles, boilers, stills, and tubes of tin or galvanized iron that are made every year.

In the manufacture of these products thousands of tons of solder are required. It is made in the form of sticks, bars, or wire, and forty or more establishments in this country are engaged in its production. There are many kinds of solder. They are divided into two principal groups: soft solders, which have a melting-point of 200° Fahrenheit or lower; and hard solders, the melting-point of which may be between 200° and 600° or more.

Soft solder consists of lead and tin in different proportions, while the composition of hard solder varies considerably, according to the purposes for which the solder is intended. Copper, zinc, aluminum, cadmium, silver, and other metals, in addition to lead and tin, enter into the composition of hard solders.

The metals, in their proper proportions, are thoroughly mixed and melted in large crucibles or kettles. When the solder, after long stirring, has reached the proper consistency, it is ladled into molds by which it is shaped into bars of certain standard shapes and weights. The process of manufacture is clearly illustrated in the pictures at the top of this page.

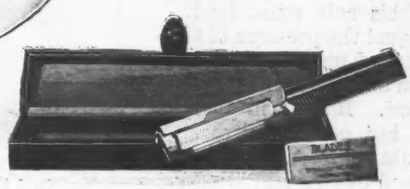
Comb Your Hair and Cut It Too

YOU need a hair-cut. So you go to the barber shop, wait till the barber is ready for you, then climb in the chair, get your hair cut, and some perfumed hair tonic you don't want. You discover, when he is through, that he has done awful things to the back of your head and that the price of hair-cuts has gone up.

Why don't you cut your own hair? Not with the scissors and a bowl, as your mother used to do, but with a cutting comb like that shown here. On each side of the teeth there is a razor blade, held in place by a clasp. The edge of the blade reaches down to within a very short distance of the end of the teeth.

To cut your hair, simply start combing, holding the comb in an upright position for the long hair on top of your head. As you come down the sides and back, flatten the comb gradually until it lies flat against your head when you reach your neck. You will soon be able to manipulate it to suit your taste. When the blades grow dull you can change them.

As he combs, razor blades, attached one on each side of the comb, cut his hair. The cutting comb comes neatly packed in a case of either khaki or leather



A specially constructed waterproof bag into which a victim of caisson disease is placed for recuperation

Bagging the Diver to Save His Life

THE diver wriggled out of his complicated suit, and was walking around, when suddenly a sharp pain shot through his head and his left arm felt curiously numb. Caisson disease! The dread of all divers. He was promptly thrust into a bag, which was sealed and pumped up with compressed air until the pressure in it was the same as that under which he had been working only a few minutes before. Then the pressure was gradually lowered to normal, and about an hour later the diver was taken out of the bag completely cured.

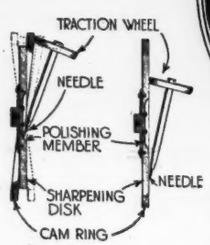
This bag for divers was invented by Hermann Stelzner. It is made of strong waterproof cloth, which, when deflated, may be rolled up so that it occupies very little space. Thus everywhere the diver goes the bag may also go. Up near the top of the bag there is a glass window through which the diver may look and be looked at. The lid of the bag is made of metal, and when closed down renders the bag absolutely air-tight. This lid is provided with a pressure-gage, a safety-valve, a blow-off cock, and means for connecting the bag with compressed-air cylinders and an air-regenerating device.

Caisson disease is caused by the too sudden return of the diver to ordinary air-pressure after he has been working under very heavy pressure. In the first place, as he is lowered into the water the air-pressure in his suit must be increased to equal the pressure of the water outside. Thus an extra supply of oxygen and nitrogen is forced into his blood. Blood will absorb the oxygen, but not the nitrogen. It forms little bubbles, and these must be forced out very gradually.

Do You Get the Point?

EVERY time you change a record, change your needle—that is one of the laws of the talking-machine. And the discarded needle? You throw it away; it is so small and inexpensive that it really doesn't count. But consider the thousands of people who are throwing with you and the combined amount of steel thrown. The waste then appears enormous.

Daniel W. Causey, of Norfolk, Va., has invented a machine that will eliminate part of this waste. It is a needle-sharpener, and in it a worn needle may be revived four or five times. Mounted on a stand is a rotary disk. This disk is divided into three sections: a sharpening surface, a polishing surface, and an outside cam. The needle-holder is adjustable and has at its end a wheel that touches the rotary disk and revolves when the disk is turned. You insert the needle and move the holder so that the needle is near the outside edge of the sharpening surface. Then you turn the handle on the right side of the machine, and the disk and needle revolve. As the sharpening goes on the needle moves across the disk, gradually working its way backward until it strikes the polishing section of the disk.



A worn-out talking-machine needle is being sharpened and polished in this machine; it will come out fully revived

By this time it is sufficiently sharp. As the polishing goes on the holder wheel reaches the adjustable cam, and this imparts a rocking movement to the needle-point and rounds it off to the desired radius. Of course, all these motions are carefully regulated in the machine. It takes about twenty seconds to perform the entire operation.

Drawing Pictures on the Typewriter

This lifelike creature was made on a typewriter from dollar signs

DON'T be too sure, when you hear your typist industriously hammering the keys, that she is working hard. She may be turning out your mail, and then again she may be punching out dollar-sign giraffes, as this typist is doing.

The combination of curves and straight lines found in a dollar sign is also found in animals, so that the dollar sign gives the best results. Eyes, ears, and shadows are indicated by striking over the same dollar sign several times.

If you want to try this and don't like giraffes, you might make cows, roosters, butterflies, or even girls. First you outline in pencil your favorite animal, then fill in the dollar signs. If your ribbon is half red and half black you can give him red eyes or a red ribbon round his neck. If dollar signs make you nervous, try the letter S.

It Helps You to Keep Away from the Dentist

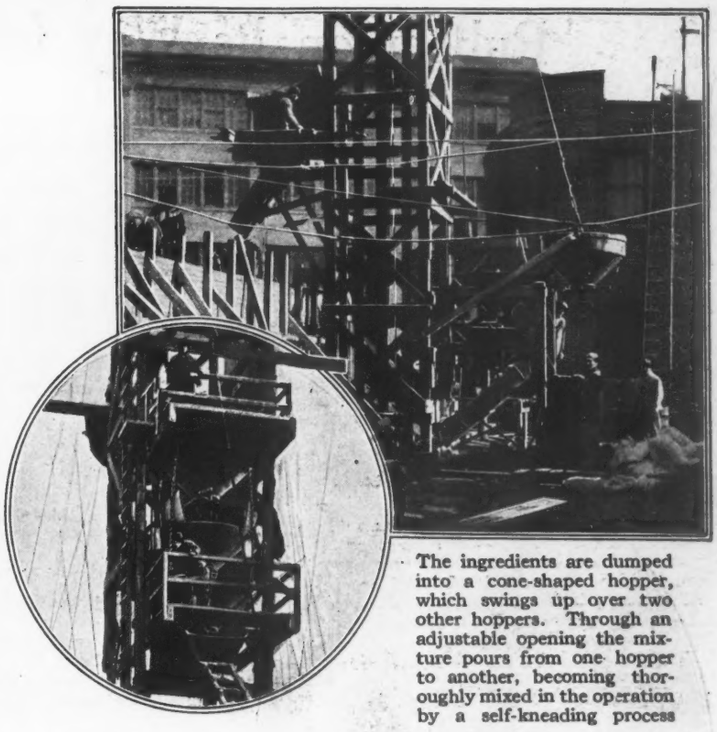
CONSIDER the shape of your teeth—how they grow. They are close together in curved formation, and are therefore very hard to clean.

You have tried a tooth-brush with even bristles and also a tooth-brush the bristles of which are shaped to fit the outside of your teeth. But how about the dark, hidden, inside spots? They often decay from neglect, for you simply can't reach them with the ordinary tooth-brushes.

The tooth-brush shown herewith was devised to clean out just those dark corners. Its back is curved up hook fashion, so that the end bristles nearly meet. Miss Gladdis Rohrbough, of Omaha, is the inventor of the contrivance.

The picture shows you how to use the brush, though of course you will not have to take out your teeth and jaw-bone in order to do it.

A tooth-brush curved like the one shown here will clean the inside of your teeth thoroughly



The ingredients are dumped into a cone-shaped hopper, which swings up over two other hoppers. Through an adjustable opening the mixture pours from one hopper to another, becoming thoroughly mixed in the operation by a self-kneading process

Here Is a Concrete-Mixer that Works Like an Hour-Glass

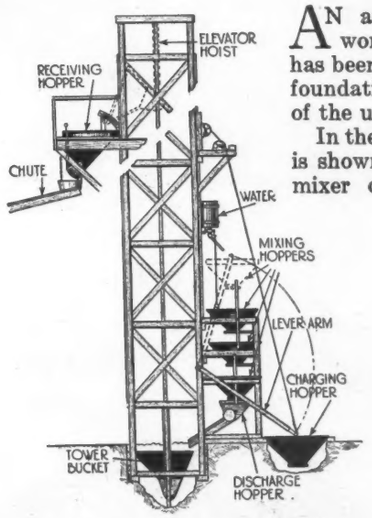
AN automatic concrete-mixing machine, that works on the same principle as an hour-glass, has been found very useful for the construction of foundations, dams, road-beds, and in fact for all of the uses to which concrete is applied.

In the accompanying photograph the apparatus is shown making foundations. Into a revolving mixer on the ground various ingredients are poured and dumped into a cone-shaped hopper. At the outer end the hopper is attached to two long arms which are riveted to a tall wooden tower. When the hopper is full it is swung upward on the elevator, by means of a cable and pulleys, to a position directly over two other cone-shaped hoppers.

An adjustable opening in the bottom of the movable hopper allows the mixture to pour out into the cone beneath it, from there into the third cone, and from the third cone into a chute, down which it tumbles into a crude elevator, which lifts it in a wooden structure to the desired point. A self-kneading process takes place in each of the three hoppers.

The walls of the cones are constructed at such an angle that the concrete will not slide downward through the opening, but will roll inward and flow out like the grains in an hour-glass.

After this operation has taken place three times in succession, the concrete is uniformly mixed, the sand, stone and cement being in a nearly homogeneous state.



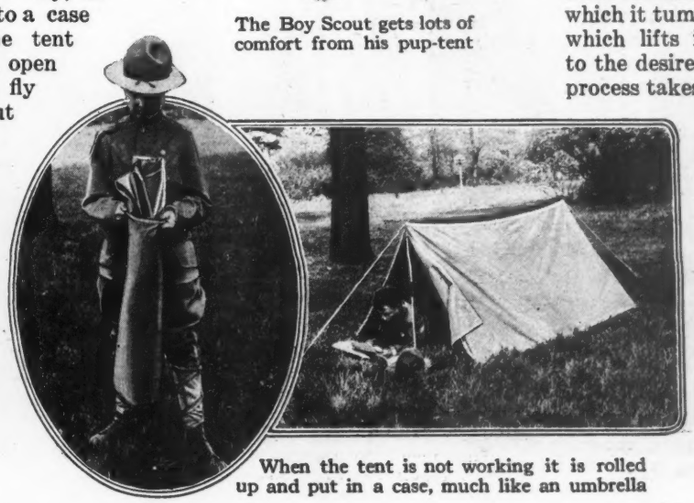
A Small Tent for Small Boy Scouts

IF, in spite of peace leagues, there should be a war twenty years hence, the Boy Scouts of today will be well prepared to fight it; for they live as nearly as possible the soldier's life. The young Boy Scout in our picture takes with him on his hikes a pup-tent. It is just about large enough to cover him comfortably when he stretches out on the ground beneath it to rest or sleep.

Then, when he goes on his way, he rolls the tent up and fits it into a case that is easily carried. The tent itself is made in one piece, open at one end and having a fly at the other. It can be put up or knocked down in a minute.

The Boy Scout movement is doing an immense amount of good to city boys. The gangs that formerly terrified peaceful citizens are fast turning into orderly groups organized under scoutmasters. They drill the boys regularly, teach them healthful games, and take them on long hikes into the country.

The Boy Scout gets lots of comfort from his pup-tent



When the tent is not working it is rolled up and put in a case, much like an umbrella

Rubber on Its Way from Tree to Tire

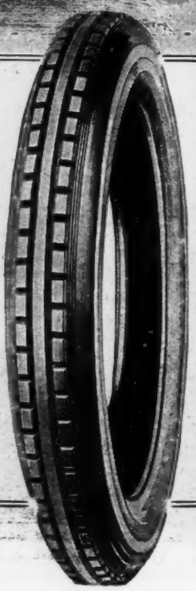
He is tapping a tree by the "herring-bone" method. Latex, the rubber fluid, runs down the small cuts into the large central one and drops into a cup on the ground

The latex is poured from cup to can, and coolies carry it off. Of the many kinds of rubber-yielding trees, the heveas are most numerous; those shown below grow in Ceylon

The sticky, crude rubber leaves the forest by way of an ox-cart; later it goes through the "curing" process

In the nursery beds of a plantation the seeds of the hevea are planted in regular rows; but when the tree is allowed to reproduce naturally it drops a pod containing three seeds. The pod explodes

Then the seeds scatter, landing about fifty feet away. This is nature's dramatic way of planting seeds so that the future rubber trees will grow up outside of the spreading foliage of the mother tree

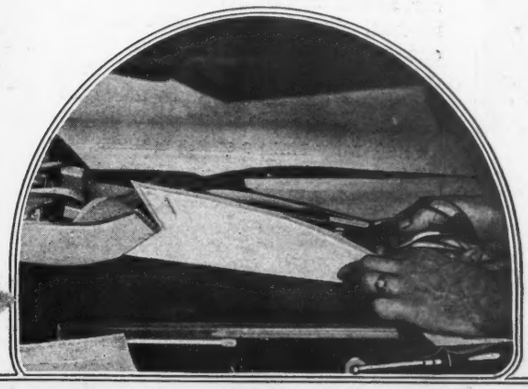


Nearly ready to leave Ceylon; the strips of rubber are being sorted before they are packed for shipping

Their last glimpse of their home land; it will not be long before they are rolling on State roads

Pretend You're a Bundle and Wear Manila Paper Suits

Harry Sussman is trimming off the edges of a paper lapel. He is a New York tailor who makes wrapping-paper suits that will last three days—if, meanwhile, it doesn't happen to rain



It fits well around the neck, though the trousers seem rather baggy. But consider the difficulties of trying to sit down without having them tear!

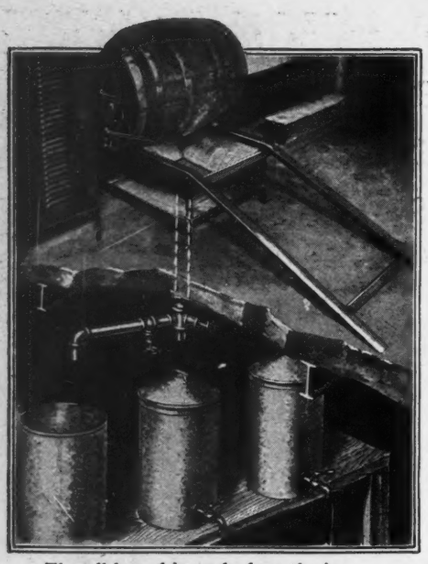
And while he cuts the coat sleeve out, his helper bastes up the trousers

He looks like thirty cents—the approximate price of the paper, pins, thread, and cement used in his suit; he will feel even cheaper if he gets wet

When basting proves that they fit, the seams are fastened with cement

On with the trousers! They boast of pockets four, while the coat and vest have but three each. Three and a half yards of paper will make the suit

Even though his careful work will survive but three days' wear, the tailor cherishes the hope that stronger paper will soon be manufactured



The oil-barrel is pushed up the incline, the bung taken out, and sufficient oil poured out to fill the containers on the floor below

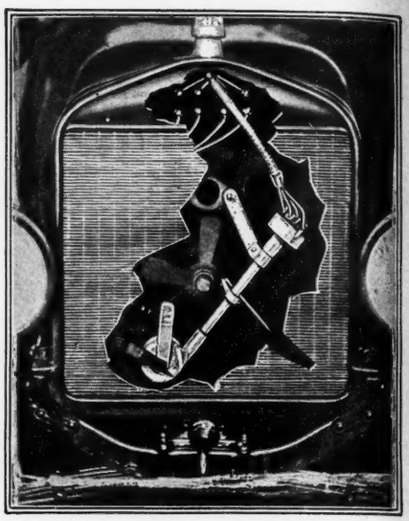
How "Doug" Keeps Fit for the Movies

DOUGLAS FAIRBANKS, who was the originator of "pep" in motion pictures, doesn't worry about hotels and restaurants while he is combing the wild and woolly plains of the West for suitable locations for his photo-plays. He travels in a "house" car that was designed and built for him.

It is a strange but cozy looking vehicle, the walls of the car forming beds when they are let down.

There is additional space inside the car, as well as a complete kitchenette, ice-box, electric lights, and all the conveniences of home.

No wonder his plots are original; for, lying out in his bunk at night beneath the great Western canopy, he naturally thinks of big things.



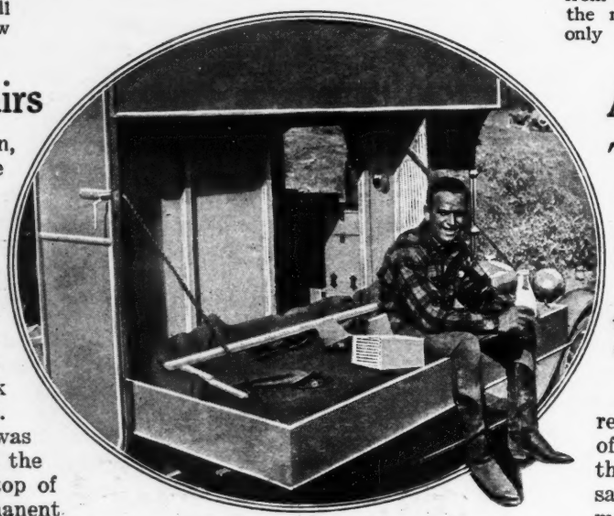
No more danger of short circuits from oil-soaked wiring if you adopt the new timing system. It takes only a few minutes to install

Keep the Oil Upstairs

AT seventy-five cents a gallon, spilling automobile engine lubricating oil is expensive. With ground-floor space in garages worth more than that on the upper floors, oil-barrels are very much in the way on the main floors.

Both of these problems were met and overcome in a large private garage in New York city in the manner shown above.

A funnel-shaped chute was provided on the top floor, and the full barrel of oil rolled up on top of the chute by means of permanent iron skids. A pipe led from the base of the funnel, down through the floor, to three tanks set up close to the wall on the floor below. A detachable swivel pipe was provided, so that the two end tanks could be filled.



This explains why Douglas Fairbanks is always in fine form. He travels comfortably in his specially designed "house" car

A New Ford Timer

THE ordinary timing system or commutator furnished on the Ford car is placed low down at the front end of the engine, where it is very likely to get dirty with oil, grease or water and thereby impair its successful operation.

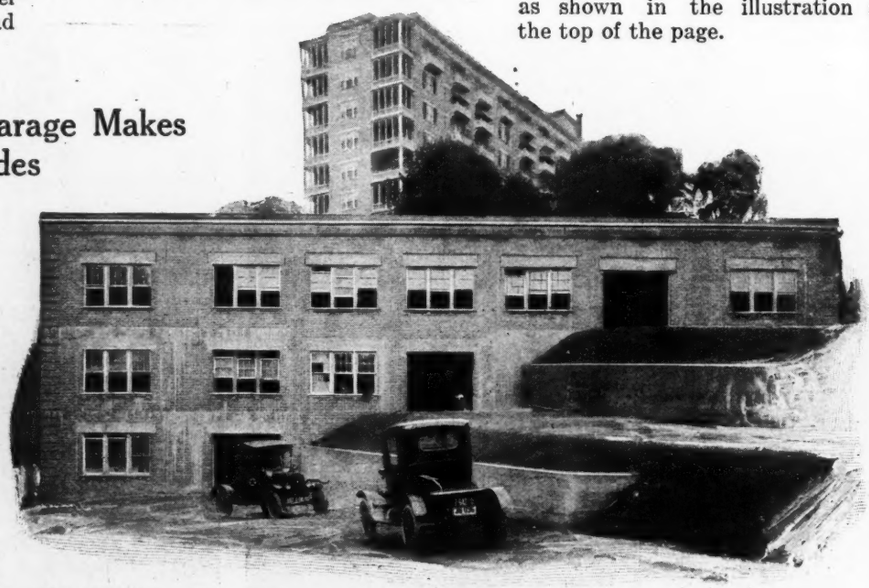
To overcome this difficulty, a Minneapolis concern has recently brought out a new type of timer, which is connected to the cam-shaft of the engine at the same point as the ordinary commutator, but in which the new commutator or spark-causing contacts are placed about half way up the height of the radiator, as shown in the illustration at the top of the page.

This Non-Elevator Garage Makes Use of Grades

THANKS to the fortune of an ideal elevation, a Washington, D. C., hotel-owner has constructed a three-story garage that eliminates all elevator service. Three direct doorways approach the varying floor levels, and hotel guests are enabled to enter or leave as quickly from the third floor as from the first.

The garage has a storage capacity of five hundred cars, one floor offering accommodation for dead storage to one hundred cars.

The approach from the street direct to each of the floors is made possible by the hillside arrangement shown in the picture.



Three distinct levels—made possible by taking advantage of a hill—permit the motorist to drive directly into the garage without the annoying wait for an elevator

Combination Farm Tractor and Motor-Truck

AS the progressive farmer replaces his horses with motor-driven farm tractors, he finds that there is considerable haulage work from his farm to the near-by town which the average farm tractor cannot do, partly because of the damage that the cleated tractor wheels do to roads. Very often he cannot afford to buy the motor-truck, and must therefore keep several horses to carry his goods to market.

However, a wide-awake tractor manufacturer has now produced a tractor with a wide range of possible speeds and an extra set of metal wheels with solid rubber tires. With such a machine there are no exasperating delays occasioned in trying to get rusted cleats off the wide tractor wheels, for it is much easier to take off the tractor wheels entirely and replace them with the solid-tired wheels.

This tractor hauls loads of from five to ten tons, in one or more trailers, without the slightest damage to the roads and at a speed of from eight to ten miles an hour—much faster than a farm-horse can travel.

To prove the feasibility of both of the claims for the new tractor, a tractor and trailer outfit recently left New York on a cross-country trip to Los Angeles, Cal. The tractor was equipped with the solid rubber-tired wheels when it started, and pulled behind it a four-wheeled trailer, also on rubber tires, in which the farm wheels and plows were carried, so that the caravan might stop at different points and demonstrate its ability in farming work when desired.

Ready at an instant's notice to take the road

"Adaptability" is this steel mule's middle name. It can easily be converted into a truck or tractor at will. The wheels are changeable

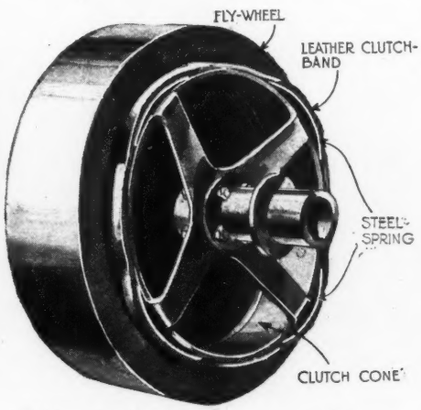
The substitution of the farm wheels for road wheels is done in much the same fashion as wire wheels are changed on automobiles, and the tractor may be taken off the road and put to work plowing in the extremely short space of twenty minutes' time.

Improving the Motor-Truck Clutch

MOTOR-TRUCK clutches that grip too quickly, when the clutch pedal is released, throw the entire weight of the truck and of the goods in the body upon the engine suddenly, with the result that the latter wears out quickly. A quick engagement of the clutch likewise causes sudden strains on all parts of the transmission mechanism, including the gear-set, driving-shaft, and rear axle members. Oil cannot be placed on the clutch surface material to ease its action, because oil will make the clutch slip.

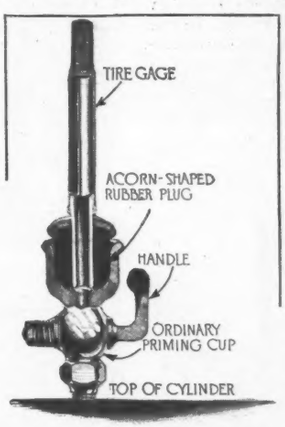
Many devices have been employed to overcome the harsh or the slipping clutch. The new method here shown has given good results. The method makes use of small lengths of clock-spring, bent to about half the radius of the clutch rim and then inserted between the rim and the leather facing of the clutch. These are placed between the rivets holding the clutch facing to the rim.

The springs should be inserted well under the rear edge of the clutch rim.



Taking the jumps out of a truck is accomplished by inserting clock-springs between the rim and the clutch leather facing

Test the Cylinder Compression by Inserting a Tire-Gage in the Pet-Cock



Attach the tire-gage to the priming-cup and see what the engine compression is in that cylinder

AFTER the automobilist has had the valves of his engine ground, one of the best methods to determine the thoroughness of the work is to test the compression in the cylinders. But how? If the job has been properly done, none of the air inside the cylinder can leak past the valves, and it will be harder to turn the engine over than would be the case if the valve did not seat properly. So it is necessary to find the compression in the cylinders in terms of pounds per square inch.

The only accessory for the car that can measure pressure is the tire air-gage, and a clever Chicago merchant has brought out a simple device that makes use of either of the two types of tire-gages now commonly in use to find the cylinder compression, without a special form of pet-cock.

Housekeeping Made Easy

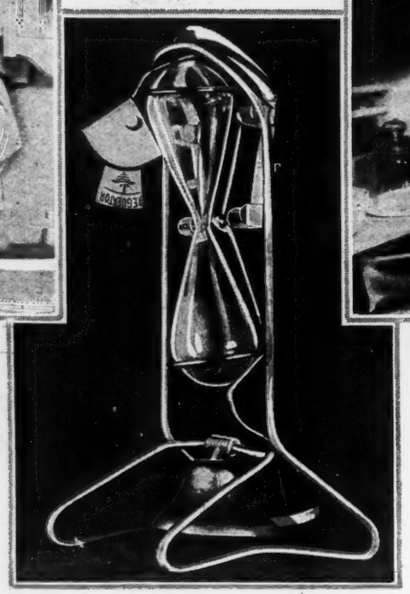
Little things that help lighten the labor of the housewife

Kitty is made of a very fine grade of steel wool. She is found useful for cleaning nickel and brass or for scouring any metal

"Betty Broom" is shown here all dressed up to protect her from the rough handling of daily use. Her dress is patent leather,

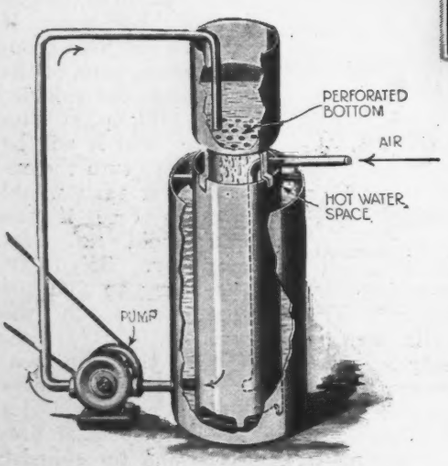
Here is the baby that lived in a shoe. The giant shoe folds up compactly and the shoe crib can be taken out into the fields so that the baby may have her nap in the fresh air

Peeling onions is a solemn occasion in every household. Why not take the automobile goggles from the automobile and wear them while peeling onions, so they will not make you weep?

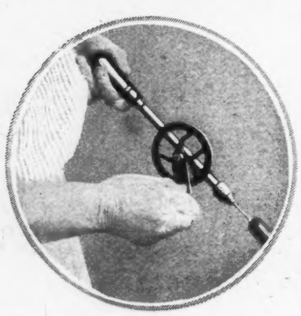


Put the eggs on the fire, set the apparatus on a near-by table, and when the eggs are ready a bell will warn you that they are done exactly right

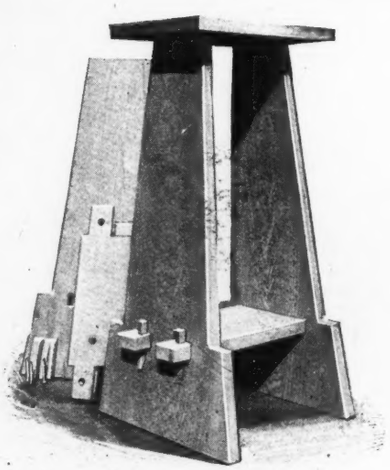
Discarded inner tubes from the automobile make excellent shoe-soles. If they are properly attached,—and anybody can learn the trick,—even walking around a wet golf course will not loosen them



When the cow browses in green pastures her taste is not so discriminating as to separate the tares from the wheat. Hence this machine, which purifies the milk



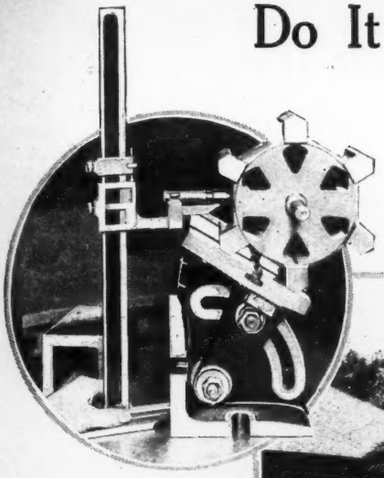
No, it is not an egg-beater. Only a tiny, tiny drill that bores holes in broomsticks or other pieces of hard wood for inserting a hook



The knock-down features of this kitchen stool reduce the shipping charges and make it possible to store the stool in a small space when it is not needed

Do It with Tools and Machines

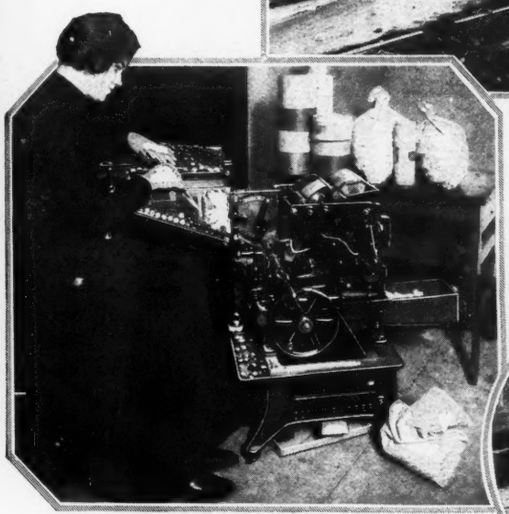
Speed up the work and at the same time save your energy



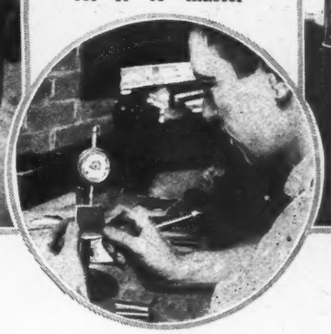
The "toolmaker's knee" permits the operator to turn his work to any angle, thus making sure to get the part he's working on in the most convenient position

A new machine so designed that it will perform the two operations of tearing up and loading street pavement on to a car pulled behind

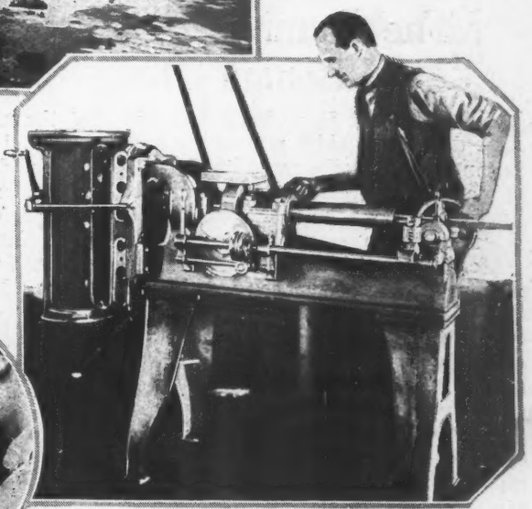
One of the new developments is a tool steel that is cast directly into the shape of the tool or die desired. It possesses the unusual quality of not changing size



With this machine this young woman counts thousands of pennies every minute. It stops automatically at a bad penny

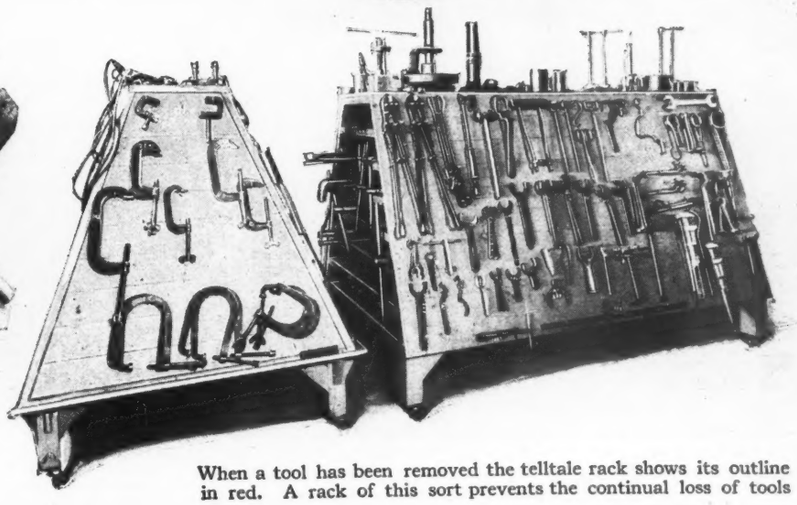


The dial gage is little, but there is no measuring problem too difficult for it to master



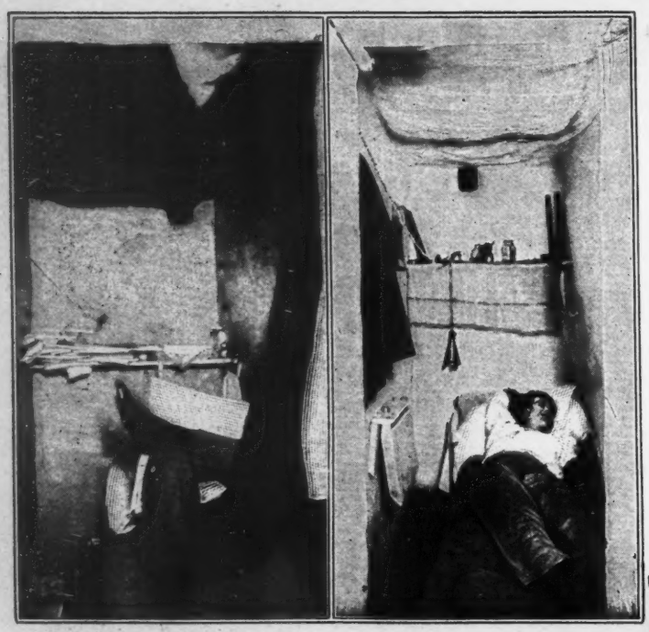
This equipment will bore any gas-engine cylinder for automobiles, tractors, trucks, stationary engines, and does it in jig time

Manufacturers say that the new chisel steel can be made so hard that it will cut glass. The picture above shows it forced through a carbon steel block



When a tool has been removed the telltale rack shows its outline in red. A rack of this sort prevents the continual loss of tools

With the heat applied directly to the point where it is needed, and only during the time necessary, this soldering-iron consumes only about one tenth of the energy that is generally required



Less perfect than McAllister's dummy, but none the less effective, was the headless dummy built by Jean Kirsher

Escaping from Sing Sing Prison, John McAllister left this lifelike dummy behind him to mislead the guards

The Dummies They Left Behind Them

KEEPERS at Sing Sing Prison say that the use of a dummy to aid a prisoner to escape is as old as the prison, and that celebrated its ninety-fourth birthday not long ago. Cleverest of all the dummies that prisoners have left to represent them is the one made by John McAllister, a burglar who escaped from Sing Sing on June 13.

McAllister molded a head from dough mixed with soap, producing a clever copy of his own features. He decked the crown of the dummy's head with hair cut from his own, using a coarse, artificial crop only for the less conspicuous sides and back. A glance at the picture will show you why the guards were fooled.

Another ingenious dummy was the creation of Jean Kirsher, who escaped from the prison three years ago. Kirsher wasn't able to build a head and face for his double, but he stuffed a pair of trousers and shoes, propped up his lay figure with legs crossed, and laid a newspaper against them. From outside the prisoner appeared to be reading quietly.

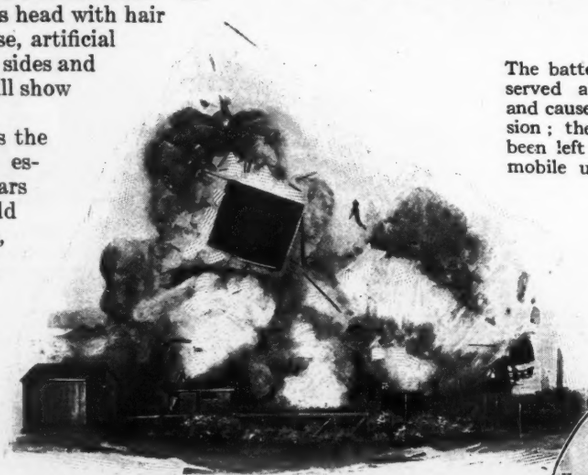
Rescuers Must Carry Their Air with Them

BANG! A coal-mine explosion. In a very few minutes a rescue squad had started down. They were curiously equipped, as the illustration below shows. They carried lamps in their hands and tanks on their backs, and over their faces they wore masks. The lamps lighted their way, the masks protected them from the poisonous fumes of carbon monoxide and carbon dioxide gases, and the tanks supplied them with oxygen to breathe.

These men could not have used ordinary trench gas-masks, which simply filter the air breathed in. For down in the mines there is little air to be had, and the rescuers must bring their own supply of air with them.

Coal-mine explosions are often caused by the ignition of coal-dust floating in the air. The explosion makes a temporary vacuum, and this is followed by the breaking of the walls and the inrush of poisonous gases. These gases cause great trouble when rescue work is being carried on.

The rescue squad is going down into the coal-mine; every man carries on his back an oxygen-tank, which will supply him with air; he also carries a lamp and wears a mask



The batteries of an automobile served as a blasting-machine and caused this first-class explosion; the blasting-machine had been left behind, and the automobile used in the emergency

They Forgot the Blasting Machine

BOLSHEVISTS watching their bombs explode before they escape in their car! Certainly that seems to be the tale of the picture to the right, but 'tis not so. It is true, though, that the men are responsible for the explosion shown above.

The men were sent out to blow up an old house which was directly in the path of a water-pipe line being laid.

After they had placed the dynamite charges and were ready to connect the charges to the blasting-machine, the machine was not to be found: it had been left behind.

Rather than waste time going back to get it, the men decided to try to detonate the shots by using the batteries of their automobile. They touched the leading wire from the charges to the car's batteries, and instantly the charges exploded.

The finishing touch — to the battery—that blew up the house. These dangerous looking men are merely carrying on their regular work

Keeping the Anchor Quiet

STARTLED by a pounding sound at the bows, the watch officer shouts:

"Lay forward and secure that anchor!"

Then he mutters something about the adjectived thing going adrift whenever the ship hits a ripple.

The same anchor that held the ship safe when, with its flukes stuck firmly in the bottom, it was doing an anchor's duty, sometimes becomes an actual menace when it is hoisted to its resting place at the bow while the vessel is under way.

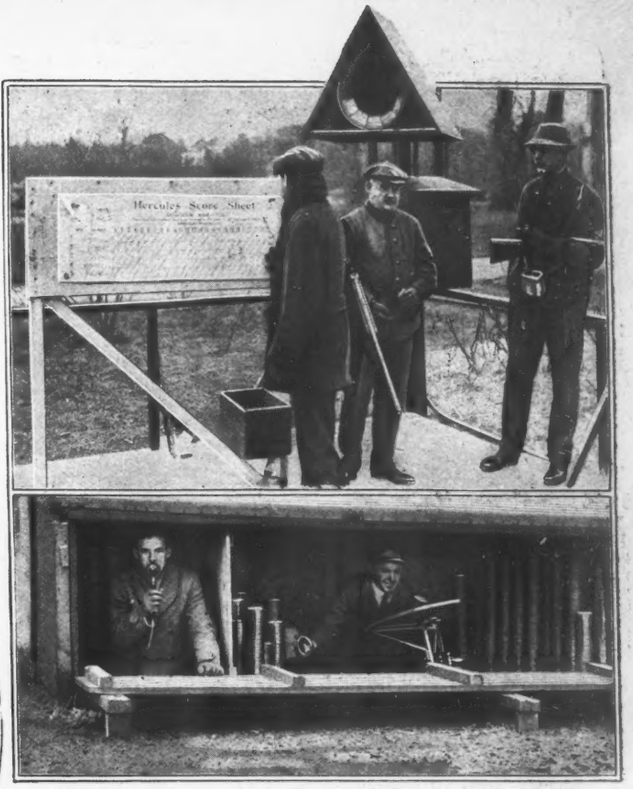
Stockless anchors—that is, anchors without the cross-bar through the shank and having their flukes pivoted to the shank—were an improvement on the old-fashioned type, but they did not fit snugly against the bows of a ship.

This bad "housing," as the seamen call it, was especially marked in modern fast ships, which are very "fine" forward and consequently have their bows slightly hollowed.

John Taylor, of East Boldon, England, noticed these things, and he has invented an improved stockless anchor in which each fluke has independent play. Each of these flukes can be adjusted independently, and fixed in position in such a manner as to fit snugly against the side of a ship.

Mr. Taylor believes that his invention will do away with the necessity for recessing the bows of ships or for having castings especially fitted to receive the anchor flukes.

While the fluke at the right is lifted, the other drops down. This independent action enables the flukes to fit snugly against the ship's bow



The upper picture shows the amplifying horn that shouts your clay-pigeon score; the lower one explains where the voice comes from—a man located in the pigeon shed near the traps

Scoring the Clay Pigeons You Shoot

CRACK! You shoot at a clay pigeon, and behind you a loud voice booms your luck.

Whence comes that voice? From an amplifying horn which is connected to a telephone in the pigeon shed, alongside of the traps. From that point a man can see best the result, and he calls the score off in his one-way telephone.

The device is used by the New York Athletic Club.

A Day's Shopping Delivered by Airplane

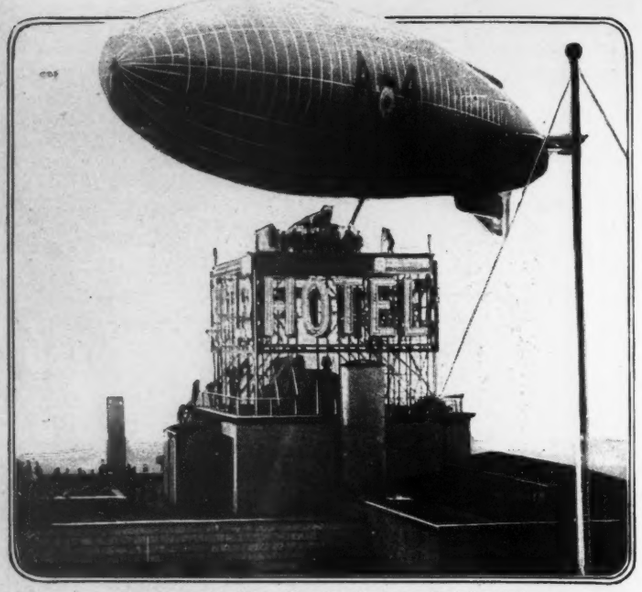
A BUNGALOW bed, a floor lamp, a fireless cooker, three pillows, some curtains, napkins, table-cloths, towels, a taboret, a carpet-sweeper, a percolator, and a rug are being tucked into the observer's seat of the Curtiss airplane shown in the picture below.

Somebody is evidently going to sleep, cook, clean, and drink coffee. The aviator? No; a suburban customer of a large New York department-store. The airplane is playing delivery wagon.

This airplane made the thirty-mile flight from store to house in twenty-five minutes, landing on a golf course near by. Since one airplane can carry all of these things, perhaps this trial flight will develop into a regular delivery airplane service. But customers of the store that send home goods by airplane will have to have large back yards or live near obliging golf courses.

Every day new uses are being found for airplanes. For some time now there has been a regular airplane mail service between New York and Washington; and the government is planning to send airplanes out to ships at sea in order to collect incoming mail. Passenger service is already in effect in many parts of the world. But using airplanes for delivery wagons is quite a new thing — though an airplane once carried a piano from London to Paris. But will it pay?

The airplane is getting a tryout as a delivery wagon for a large department-store; it is loaded with merchandise for an out-of-town customer



In a most businesslike fashion the A-4 landed two guests on the roof of a Cleveland hotel

Will Dirigibles Land on Roofs?

A DIRIGIBLE sailed from Akron to Cleveland, Ohio, recently, landed on the roof of a hotel, deposited two passengers, and fifteen minutes later cast off and sailed back to Akron.

Sounds rather tame, doesn't it, after the thrills of a transatlantic air race? And it looked rather tame, too, to the thousands of Clevelanders who saw the great gas-bag, 160 feet long, come gracefully to rest on a little thirty-foot platform built on top of the hotel's electric sign. But it was the first time in the history of aviation in America that an airship was successfully landed on a roof in the heart of a city.

The two passengers were Ralph H. Upson, an aeronautical engineer of Akron, and Major C. H. Maranville, flying instructor at Wingfoot Lake, an army balloon school near Akron.

The dirigible left Akron at 5.30 P. M., and, fighting a strong head-wind all of the thirty-five miles to Cleveland, was soaring over the hotel roof at 6.36 o'clock. Twenty-five students from the flying-field had been stationed on the hotel roof to handle the big "blimp."

The airship circled the roof several times before nosing up to it from the windward side; but treacherous air currents were encountered, and the airship was swept away before the anchor ropes could be cast out. The machine circled around and made another attempt, but unsuccessfully.

Then Pilot James Schade tried circling round past the hotel and letting the balloon drift over, using the power of the propeller to head it into the wind and bring it to a standstill just over the landing platform.

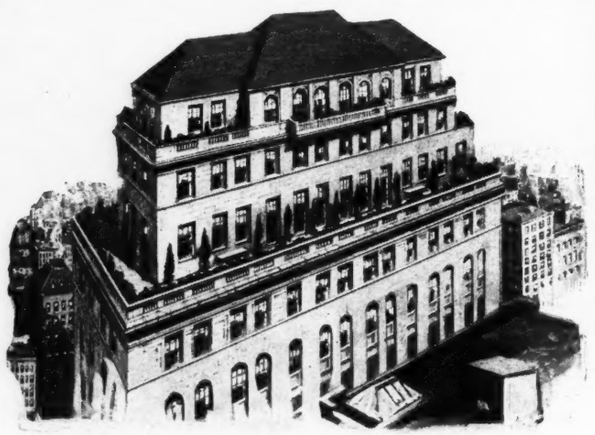
Not until the seventh trial was the attempt to land successful. Then the carriage of the dirigible was brought to a perfect standstill above the landing platform, several anchor ropes were cast out, and in a few seconds the big bag had been hauled down to the platform and securely lashed.

Two curious objects hung below the car. They were cylindrical air-inflated buffers, which kept the car from bumping and breaking the propeller.

A Country House and Garden on Top of a Skyscraper

A THIRTEEN-STORY apartment hotel is about to be erected in New York, and on the roof of this hotel there is to be—what? A three-story Colonial mansion having twenty rooms, seven baths, a garden, pergolas, balconies, and countless flower-pots! We had thought of renting this "country home in the heart of the city" when completed. But the rent—! A trifle of $30,000 a year. We retire chastened to our modest apartment.

We wish we had that $30,000. Fancy, an elevator traveling at six hundred feet a minute, twice the speed of the ordinary apartment-house elevator, to take us up to our new home from the ground floor of the building any time we liked. And then, the southerly and westerly exposure, with every room open to the light and air! A grand stairway leads up to the second story of the house,



A Colonial mansion on a New York roof. It has twenty rooms, seven baths, a garden, sleeping-porches—all at a modest yearly rental of $30,000

and of the seven rooms and six baths on this level (what would we do with six of 'em?) the smallest room is ten by fourteen feet. On the third floor is a large studio, twenty by thirty-one feet in size, where we would think up new ideas for the POPULAR SCIENCE MONTHLY; the studio has a pitched ceiling, giving the room that atmosphere which we now so sadly lack.

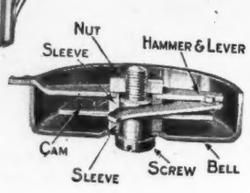
According to the real estate prophets, New York is soon to be graced with other structures of this character.

If the speed of the cream-separator falls below the point of efficiency, a bell rings

When the Bell Rings, Speed Up the Separator

EVERY dairyman knows that, to obtain the best results, the crank of a centrifugal cream-separator must be turned with considerable speed. The invention here shown indicates when the speed falls below the limit of efficiency.

A steel bell is attached to the gear end of the crank-shaft, revolving with it. Inside of the revolving bell is a hammer lever riding on a cam. When the crank is turned slowly, one fork of the hammer lever drops into a slot in the cam at every revolution and causes the other fork to ring the bell. If the bell is quiet the speed is right.



Getting More Out of the Gas Engine

One of the most remarkable inventions of our time—an engine using both steam and gas

EVERYBODY has noticed the steam that issues from the top of a radiator on an automobile or motor-truck. To generate that steam, heat has been wasted. And then the exhaust—how much heat is wasted when the burnt gases are discharged! Is there no way of utilizing the energy thrown away in heating the cooling water and in the exhaust, no way of getting more out of the gas or the gasoline engine?

The patent records bulge with proposals to use all the jacket and all the exhaust heat in raising steam in a small separate boiler for the purpose of driving air auxiliary steam engines. A proportion of the heat can be usefully recovered from the exhaust gases; but the cooling water from the jacket is of little value, its temperature being too low. But suppose the temperature of the cooling water could be maintained at that of steam at useful pressure? Surely the efficiency of the engine would be improved. That is what William Joseph Still, an English inventor, has done.

The Still engine is both a combustion engine and a steam engine. The charge of gas and air is admitted on one side of a piston and exploded; then the piston is driven back again by steam-pressure on the other side. Never before has such an engine been designed and constructed.

Using Engine's Wasted Heat

The unutilized heat of the gas engine is made to play the part of a fire under a boiler. It heats the water in the jacket of the cylinder, and the jacket in turn forms part of the circulating system of a steam boiler. Hence the cooling water enters and leaves the jacket at a constant temperature, regulated by the pressure of the steam. Cooling is effected by converting the water into steam without raising its temperature. All the waste heat that passes through the walls is thus usefully recovered in the water as steam.

During compression the incoming charge absorbs heat instead of losing it, because the walls are at steam temperature, and during combustion and expansion the uniform and higher mean temperature of the walls reduces the heat lost to the jacket water. Some of the heat thus economized adds to the useful work on the piston, the balance passing out in the exhaust gases for recovery.

William Joseph Still, the English engineer who has developed a combination steam and gas engine

Part Played by Exhaust Gases

The exhaust gases play a minor but also important part. After raising their quantum of steam, they are employed in preheating all the water required for the steam generated in the jacket water and in the boiler.

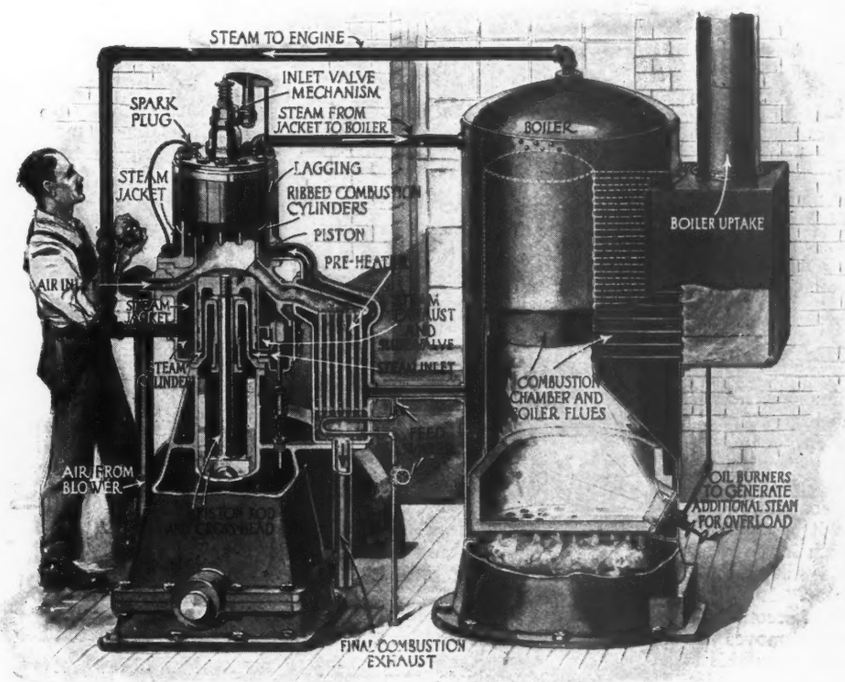
Still's primary object is not to use the waste heat for raising steam, but first to use it in improving the heat conditions of the working cylinder and so make sure that he is getting the most from the fuel burned within it.

In Still's engine the steam on one side of the piston actually increases the efficiency of the explosion operation on the other side. What is more, the explosion operation on the gas side increases the efficiency of the steam side. There is no condensation, no loss or waste.

In the Still engine twenty-nine per cent additional brake horsepower is added to the shaft of the engine without increase in the fuel consumption if the steam is not condensed. Forty per cent is added if a condenser is used.

The steam generated by the heat rejected by the combustion of gas warms the engine before starting. The steam generated starts the engine against load, if necessary. Moreover, the use of steam makes it possible to run at any speed from zero to maximum for any period—something long desired.

Starting is unaffected by atmospheric conditions. Power at normal loads is developed by combustion and steam from waste heat alone with an efficiency of at least twenty-five per cent above any known combustion engine of similar proportions. Additional steam generated by a fire under the boiler gives a large range of overload without serious loss in efficiency.



In this remarkable invention—an engine that uses both steam and gas—the piston first sucks in a charge of gas and air. The explosion of the charge drives the piston down. Steam-pressure on the other side then drives the piston up. The steam is generated by making the water-jacket part of the circulating system of a boiler. The exhaust gases are used to preheat the feed water. The primary object of the system is to use it in improving the conditions under which the cylinder must work, and thus to attain the maximum efficiency of the fuel burned within it, saving heat

Finding Your Way Among the September Stars

"Job's Coffin" and other interesting things that are to be seen in the sky this month

By Ernest A. Hodgson

THE evening skies for September begin to give promise of the coming of the winter constellations. The circular star map shows us the Pleiades rising about 9 P. M. at the middle of the month. By the following month Taurus will be rising at that time in the evening.

The constellation—or rather constellations—chosen for special study this month are those of Delphinus and Aquila. Delphinus, the Dolphin, is sometimes referred to as "Job's Coffin." It is easily recognized by its small parallelogram, with the added line toward the south from the western corner. It is rather isolated, and may readily be picked out by looking a little to the south of the zenith along the meridian at the middle of the month. Looking in the same general direction, the group should easily be recognized at any time during September.

Of the stars in the group, two are seen as doubles in a small instrument. Alpha, the upper right-hand star of the parallelogram, is a double of magnitudes 4 and 9.5, and is widely separated—thirty-five seconds of arc. One second of arc is the angle subtended (by three inches) at the distance of 1 mile. Gamma, the upper left-hand star of the parallelogram, is not so widely separated, but it is a very beautiful pair of stars, one yellow and the other bluish green, magnitudes 5.5 and 4.5, separated by about twelve seconds of arc.

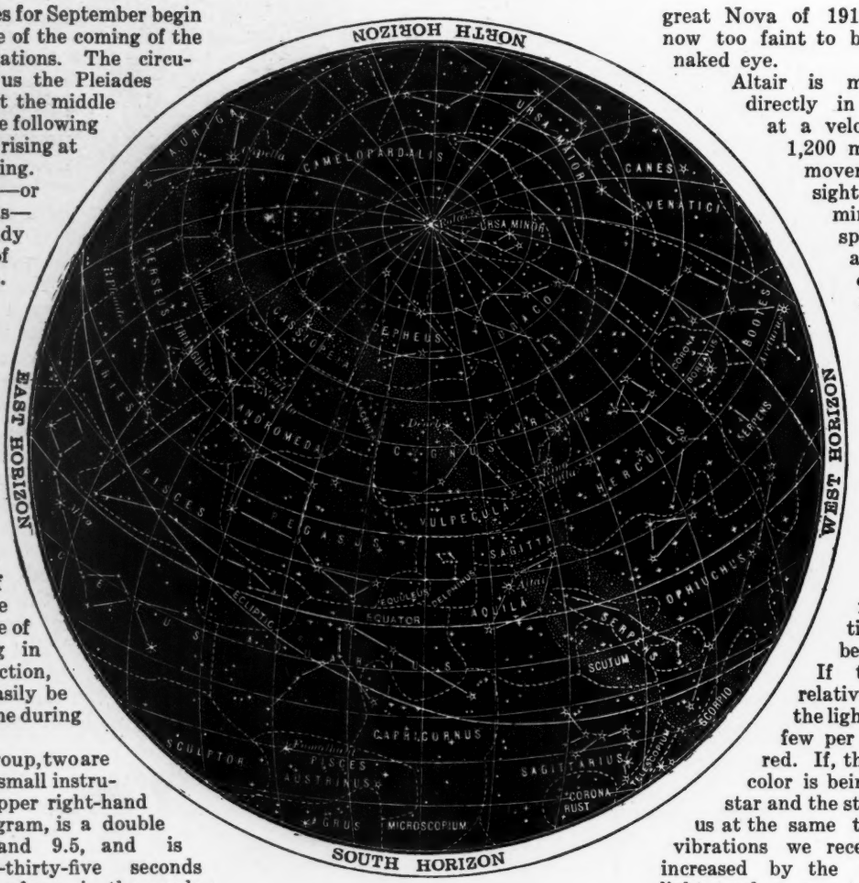
The Bright Star in Aquila

To the west of Delphinus and a little to the south lies Altair—the bright star of the constellation Aquila, the Eagle. The constellation may be recognized by its formation about Altair. The latter may be recognized by its bright companion star, a couple of degrees above it. Altair is one of the nearest bright stars in view in the northern heavens. It is situated only fourteen light-years distant. It is moving with a proper motion of .65 seconds of arc per year; that is to say, it moves about one degree in 5,540 years. As this is a relatively fast proper motion, it is easily seen why the stars are spoken of as "fixed."

Aquila is in the Milky Way, and as a consequence the sky at that point is an interesting sight in a small telescope or opera-glass. It was in Aquila—just to the south and west of Altair—that the great Nova of 1918 appeared. It is now too faint to be picked out by the naked eye.

Altair is moving toward us directly in the line of sight at a velocity of more than 1,200 miles a minute. This movement in the line of sight has been determined by means of the spectroscope, which analyzes the light received from the star, and determines the velocity toward or away from us by the relative colors of light from certain incandescent substances shining in the star and the colors of the same substances raised to incandescence in the laboratory.

The color of light depends upon the rapidity of the vibrations of the ether, bearing the light energy. If the vibrations are relatively many per second the light is violet. If relatively few per second the light is red. If, then, light of a certain color is being sent out from the star and the star is rushing toward us at the same time, the number of vibrations we receive per second is increased by the movement and the light tends more toward the violet. If the star is moving away we get fewer vibrations per second and the light is shifted toward the red. The amount of shift is proportional to the speed of the star in the line of sight. Hence, measuring the shift enables us to determine the velocity and the direction to or away from us.



The Star Map for September

This map represents the appearance of the sky at the times listed below. It is specifically arranged for the latitude of New York, 40 degrees north, but is practicable for ten degrees on either side of this latitude.

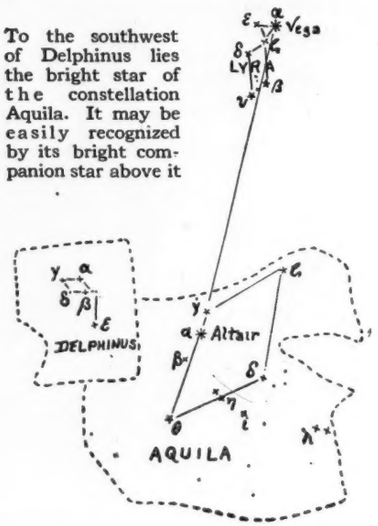
August	7,	midnight.
August	15,	11:30 p. m.
August	22,	11:00 p. m.
August	30,	10:30 p. m.
September	6,	10:00 p. m.
September	14,	9:30 p. m.
September	22,	9:00 p. m.
September	29,	8:30 p. m.
October	7,	8:00 p. m.
October	15,	7:30 p. m.
October	22,	7:00 p. m.
October	30,	6:30 p. m.
November	6,	6:00 p. m.

The magnitudes are indicated on the map by stars of various kinds as follows:

0 magnitude, open center
1 magnitude, 8 points
2 magnitude, 6 points
3 magnitude, 5 points
4 magnitude, 4 points
5 magnitude, single dot

All times expressed in Eastern Standard (not summer) time.

To the southwest of Delphinus lies the bright star of the constellation Aquila. It may be easily recognized by its bright companion star above it



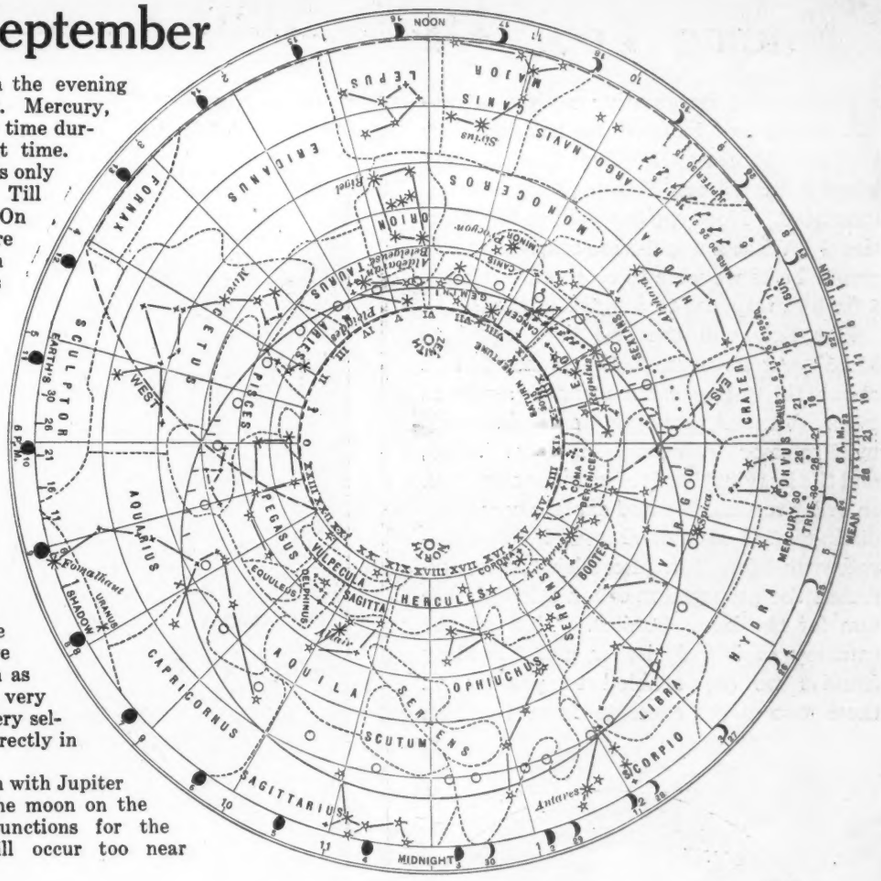
The Planets for September

OUR beautiful showing of planets in the evening sky is over at last. None are left. Mercury, the only one to set after the sun at any time during the month, is very near it at that time. It is in conjunction on the 26th, and it is only from then on that it sets after the sun. Till then it rises before it in the morning. On September 1 it may be seen rising before the sun, since it is then about eighteen degrees to the west of the latter and rises about an hour before it.

Mars may be seen as a morning star, and so may Jupiter; but Saturn and Venus are still too close to the rising sun to be seen for its glow. Mars and Jupiter are in conjunction with each other on September 1, and the conjunction is to be very close. Venus and the sun are in conjunction on September 12, the conjunction being "inferior"; that is, Venus passes between us and the sun.

It will be noted that Venus is retrograding at this passage. The conjunction is always "inferior" when Venus reaches conjunction on retrograding. The planet will pass below the sun, and so we shall not be favored with what is known as a "transit of Venus." That would be a very interesting phenomenon, but one that very seldom occurs where the planet passes directly in front of the sun's disk.

There will be a conjunction of the moon with Jupiter on September 19, and one of Mars and the moon on the 20th of September. The other conjunctions for the month will be invisible, since they will occur too near the sun.



To use this planet map, cut out the disk below and use it as explained in "How to Use the Planet Map"

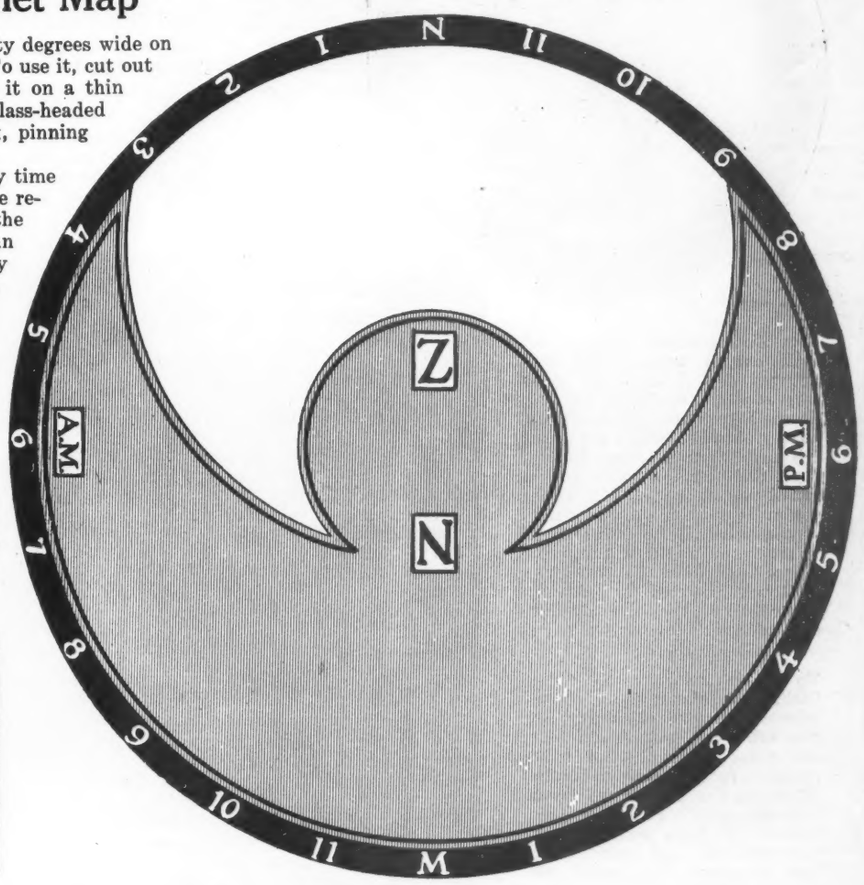
How to Use the Planet Map

THE planet map indicates a belt thirty degrees wide on each side of the celestial equator. To use it, cut out the circular disk to the right and mount it on a thin cardboard disk of the same size. Run a glass-headed push-pin through the center of the disk, pinning it to the center of the map.

To see the section of sky visible at any time on any given date, turn the disk until the required hour on the disk is opposite the required date on the chart line of the "mean sun." To see when any celestial body rises or sets or reaches the meridian *on any date*, turn the disk so that the position of the body *for that date* on the map is in the required position with respect to the horizons. Read off the hour opposite the position of the mean sun *for that date*.

The planets are designated by the following signs:

MERCURY	☿	SATURN	♄
VENUS	♀	URANUS	♅
MARS	♂	NEPTUNE	♆
JUPITER	♃	SUN ☉ AND MOON ☾	

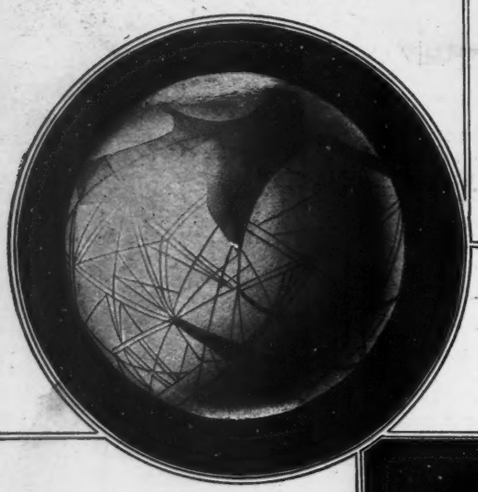


The POPULAR SCIENCE MONTHLY *is publishing every month an article like this by Mr. Hodgson. If you feel that these articles can be made more helpful, write to the editor. And if there are any questions that you would like to ask about stars, send them along*

"Hello, Mars—This Is the Earth!"

THE more imaginative modern astronomers are inclined to believe, with the late Professor Percival Lowell, that Mars is inhabited. Assume that Mars is inhabited. How can we talk to the Martians? What a world-wide sensation there would be if we were to receive from Mars a flash in response to a signal of ours!

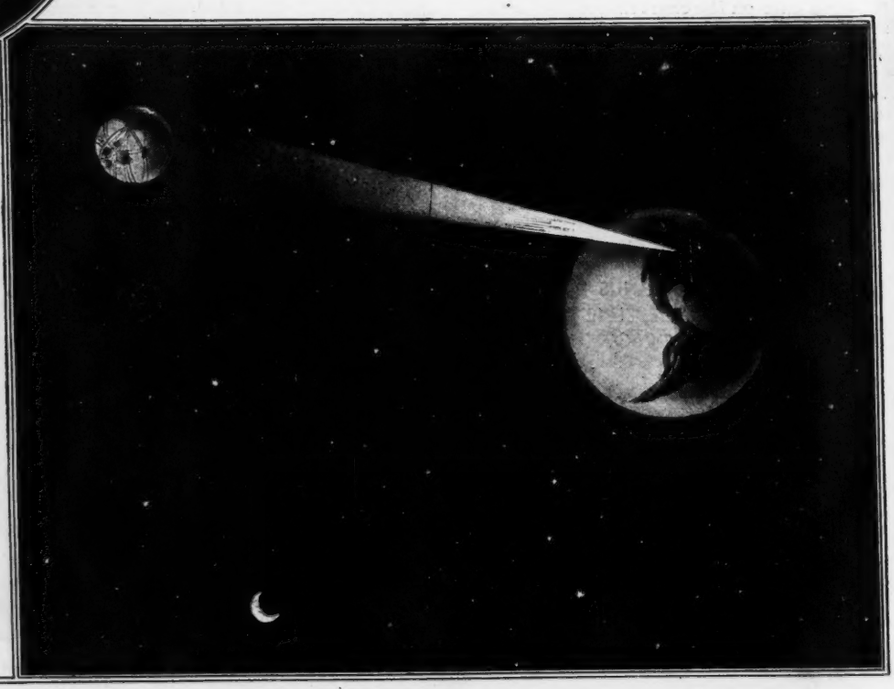
But how will the scientists signal to Mars? At its nearest, the planet will be about thirty-five million miles away in 1924. Various proposals have been made by Professor Pickering, Professor Wood, and the imaginative Professor Flammarion. In order to visualize and explain how these distinguished astronomers will communicate with Mars, Mr. Max Fleischer has directed the preparation of a motion-picture film for the Bray Studios. Through the courtesy of Mr. Fleischer and the Bray Studios we are enabled to present on these two pages excerpts from the film



The well known French astronomer, Professor Camille Flammarion, to popularize the notion of Mars' habitability, suggested that an electric lights. It would be a costly experiment. A huge tract of Sahara, for instance—would have to be "planted" with the lamps would have to be generated in a power house big once said that he hated to die rich. Here is a chance to

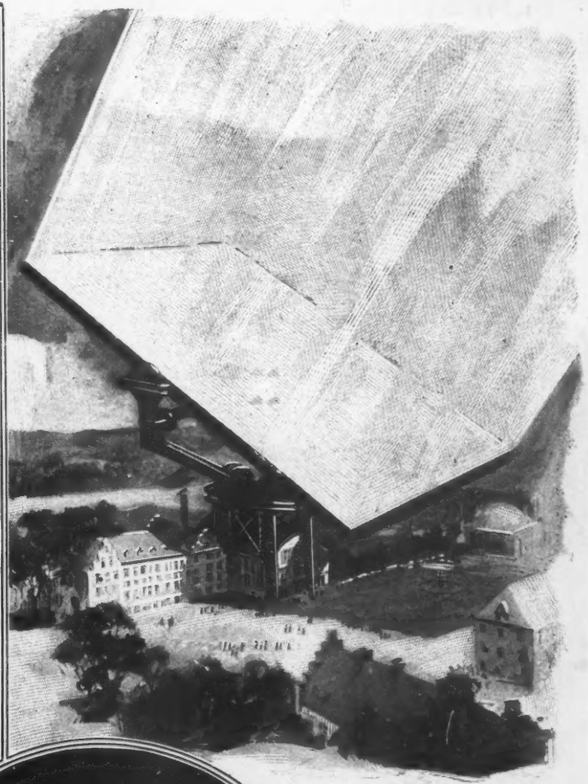
The distinguishing features of Mars are its "canals," first discovered by Schiaparelli and later minutely studied by Lowell. It was Lowell who advanced the theory that the canals are great irrigation ditches. Mars has almost dried up. Water is to be found only at the poles. If vegetation is to flourish, the water of the melting polar snows must be conducted to the arid regions. Hence the canals. Several hundred were charted by Lowell. The canals are the only evidences of intelligent life that we have

To the right we have the earth flashing a message to Mars. Who knows but some day we may tell the Martians all about our great war, all about the struggle for democratic ideals, all about the terrible upheaval through which we have just passed! Perhaps we will learn from an older and wiser planet how we ought to run the Earth

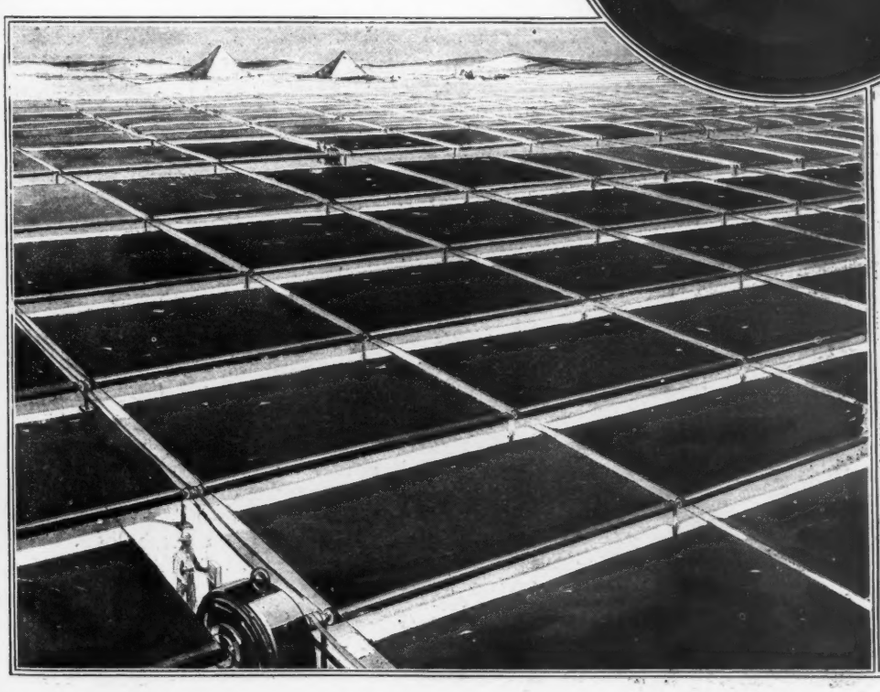


Will the Martians Answer Us?

who has done more than any other man in Europe enormous area on the Earth should be covered with of land—a considerable portion of the Desert millions of lamps. The current to illuminate enough to run a railway. Andrew Carnegie get rid of several million dollars at one swoop

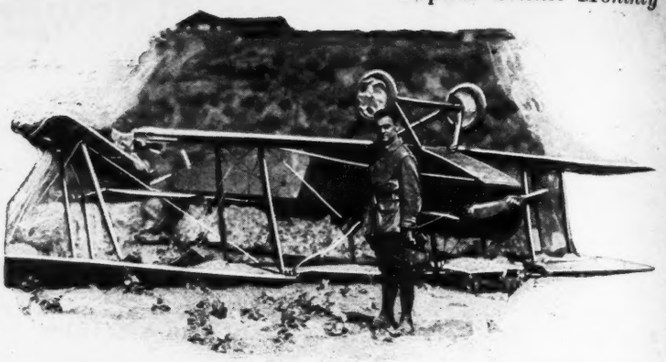


Professor Pickering, of the Harvard College Observatory, suggested that a huge mirror be mounted, to swing on an axis so that it can reflect the sun's rays to Mars from any angle. It would take an enormous power plant to flash dots and dashes to the wondering Martians. And what would they see? As the picture on the left shows, a luminous spot which alternately glows and extinguishes itself

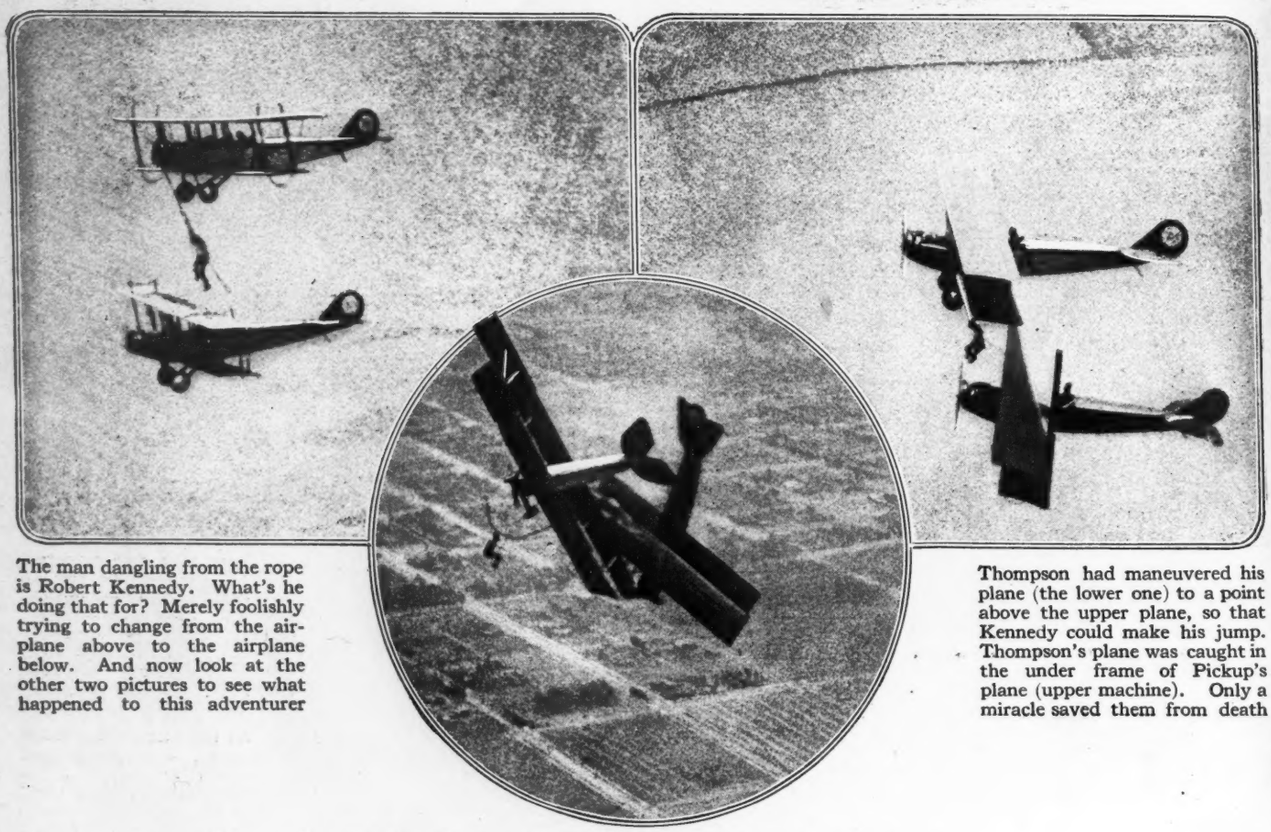


The picture at the left looks like a neatly cut-up farm. It represents Professor R. W. Wood's proposed method of communicating with Mars. The Professor would cover some huge white space on the earth, a portion of the Desert of Sahara, for instance, with strips of black cloth. These strips he would wind and unwind by means of electric motors. The result would be a series of winks. When the black strips are wound up, the white sand below reflects the sun's rays; when the strips are unrolled, the white area is covered. This is probably the cheapest method of optical signaling yet proposed

Swapping Airplanes in Mid-Air



Cast your eye to the right and see what happened when Robert Kennedy, a former army pilot, tried to change in mid-air from Lieutenant C. Vernon Pickup's airplane to Lieutenant David G. Thompson's. Kennedy was the only one who was hurt. Are miracles never going to cease?



The man dangling from the rope is Robert Kennedy. What's he doing that for? Merely foolishly trying to change from the airplane above to the airplane below. And now look at the other two pictures to see what happened to this adventurer

Thompson had maneuvered his plane (the lower one) to a point above the upper plane, so that Kennedy could make his jump. Thompson's plane was caught in the under frame of Pickup's plane (upper machine). Only a miracle saved them from death

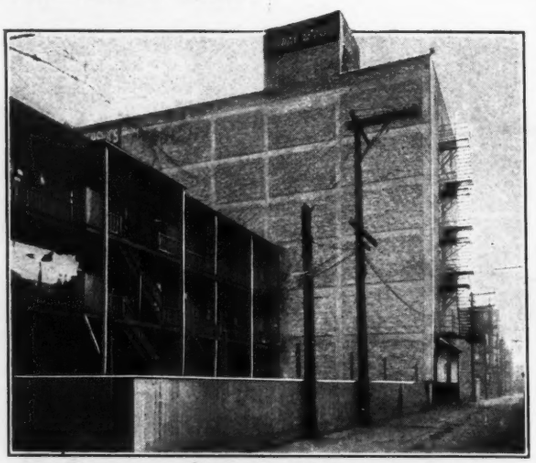
And here the two interlocked planes are shown plunging down to what seems to be certain destruction. Yet only one man was hurt, and he will live to repeat the experiment if he hasn't cooled off since

It's Fireproof, as You Can See

ANY storage company can claim that its building is fireproof and that the rooms are separated by concrete floors and walls; but it took an enterprising Chicago company to make the fact visible to anybody who happens to look in the right direction.

The concrete partitions, instead of ending, as usual, at the walls, have been extended right through them to the outside of the building.

It is said that this method of construction offers no engineering difficulties, and of course it is easy to see that in a public warehouse of this kind it would have an extraordinary advertising value.



A storage warehouse in Chicago takes pains to let everybody know that it is really fireproof. Its concrete partitions are extended outside the walls, to be seen by every passer-by

The Beetles Stayed

RECENTLY a carload of beetle-infested potatoes arrived in Los Angeles. The startling thing about this was that the car came from Idaho, where the potato-beetle is extinct.

An investigation was made by Frederick Maskew, state quarantine officer of California, and it was found that the same car had been used a little earlier to carry a load of potatoes out of Colorado, where the beetle flourishes. Obviously, after these potatoes were removed, the beetles lurked in out-of-the-way corners, waiting for a fresh load. The Department of Agriculture is taking steps to have freight-cars cleaned at the point of unloading in the future.

All Aboard the Air-Liner

Think of battling storms a mile up! Think of cooking with the exhaust of engines! Think of landing in America with a parachute!

By Waldemar Kaempffert *and* Carl Dienstbach

DO you remember that old story by H. G. Wells, "The War in the Air," in which he describes minutely an airship trip from Frankonia to New York? It will strike those who read it in 1908 as one of the truest prophecies ever penned—only, the trip took place at the *end* instead of the beginning of the "great war."

At Mineola the R-34 looked for all the world like a big (yet not overlarge) sea-vessel in a harbor. The paraphernalia scattered about lent color to the view—apparatus analogous to buoys, boats, coal lighters, etc. There were lengths of heavy hose for water ballast, lighter hose for injecting hydrogen into the depleted gas-chambers, huge mounds of steel hydrogen bottles, auto-trucks with fuel, and wheeled ladders for inspecting the hull and rudders, not to forget a ring of search-lights with their heavy electric cables trailing over the ground.

In the Wheel-House

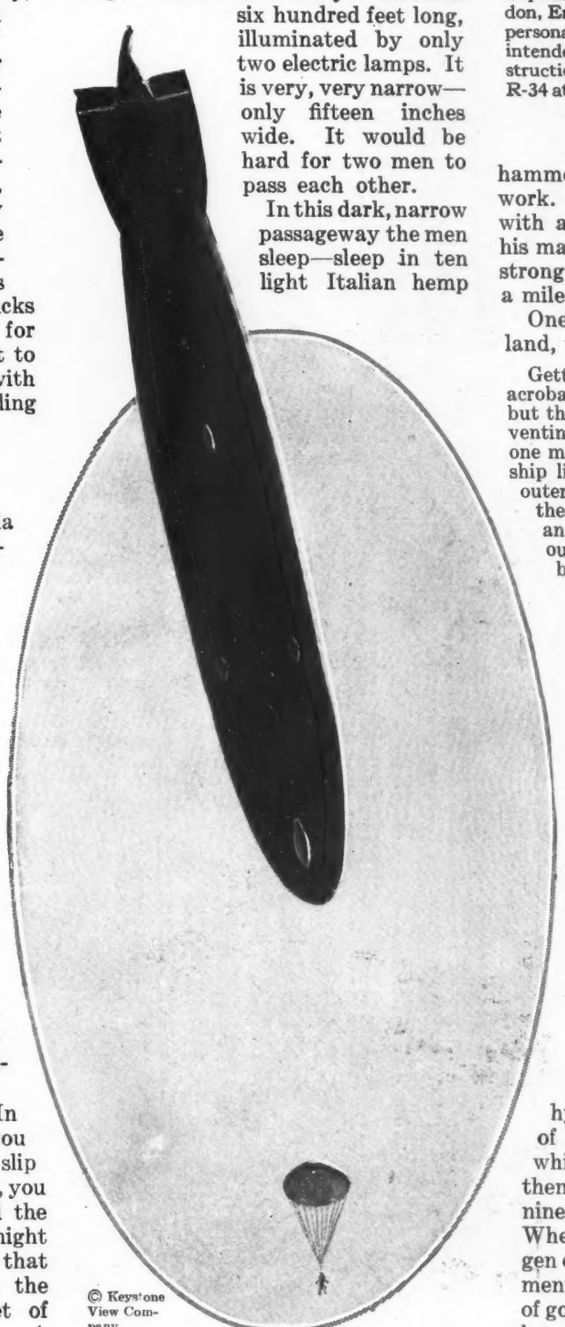
Step into the forward gondola of the R-34. How like the wheel-house of a ship it is! See, here are the usual speaking-tubes, electric bells, and signals. What are these wheels on the side? They control the elevators when the ship is to climb or to glide down. This little cubby-hole is the navigator's office. As you see, it has a table on which the charts can be spread.

Over the chart table Scott and Cooke spent much of their time with protractors, dividers, and many navigational text-books, measuring angles of drift and calculating course made good. Aerial navigation is more complicated than navigation on the surface of the sea. Note that in a separate sound-proof compartment back of the forward engine-room is the radio station.

Where does the crew sleep? In the big envelope above. Would you like to see for yourself? Here, slip on these felt shoes. Why? Well, you will have to climb a ladder, and the nails in your leather shoes might strike a spark. Remember that this great craft is supported in the air by thousands of cubic feet of highly inflammable hydrogen. A spark—!

Step this way, please. See, this is the way up into the envelope—this pipelike vertical passage, in which an aluminum ladder is placed. You are in the huge envelope now. Better light your hand flash-lamp. It's dark, as you see. This foot walk along the keel on which you stand is six hundred feet long, illuminated by only two electric lamps. It is very, very narrow—only fifteen inches wide. It would be hard for two men to pass each other.

In this dark, narrow passageway the men sleep—sleep in ten light Italian hemp hammocks suspended from the framework. Each man shares a hammock with another. One man sleeps while his mate is on duty. Only a man with strong nerves can sleep in this fashion a mile in the air.



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Major Pritchard, on board the R-34, didn't wait for the ship to land. He jumped overboard with a parachute

Major G. H. Scott is thirty-six years old. Five years ago he was flying airplanes at Hendon, England. He personally superintended the construction of the R-34 at Inchinnan

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One of the passengers, General Maitland, writes in his diary:

> Getting into one's hammock is rather an acrobatic feat, especially if it is slung high, but this becomes easy with practice. Preventing oneself from falling out is a thing one must be careful about in a service airship like the R-34. There is only a thin outer cover of fabric on the under side of the keel on each side of the walking way, and the luckless individual who tips out of his hammock will, in all probability, break right through this and soon find himself in the Atlantic.

Running along the 600-foot cat's-walk, inside the envelope, are the parachutes and pneumatic life-belts, kept in canvas containers. Both parachutes and life-belts are always available. If the men should be forced to leave the ship while it is over land, the parachutes will save them. Over the sea, parachutes and life-belts would be used. Every man dons a life-belt almost as soon as he steps on board.

Where the Gas and Fuel Are Stored

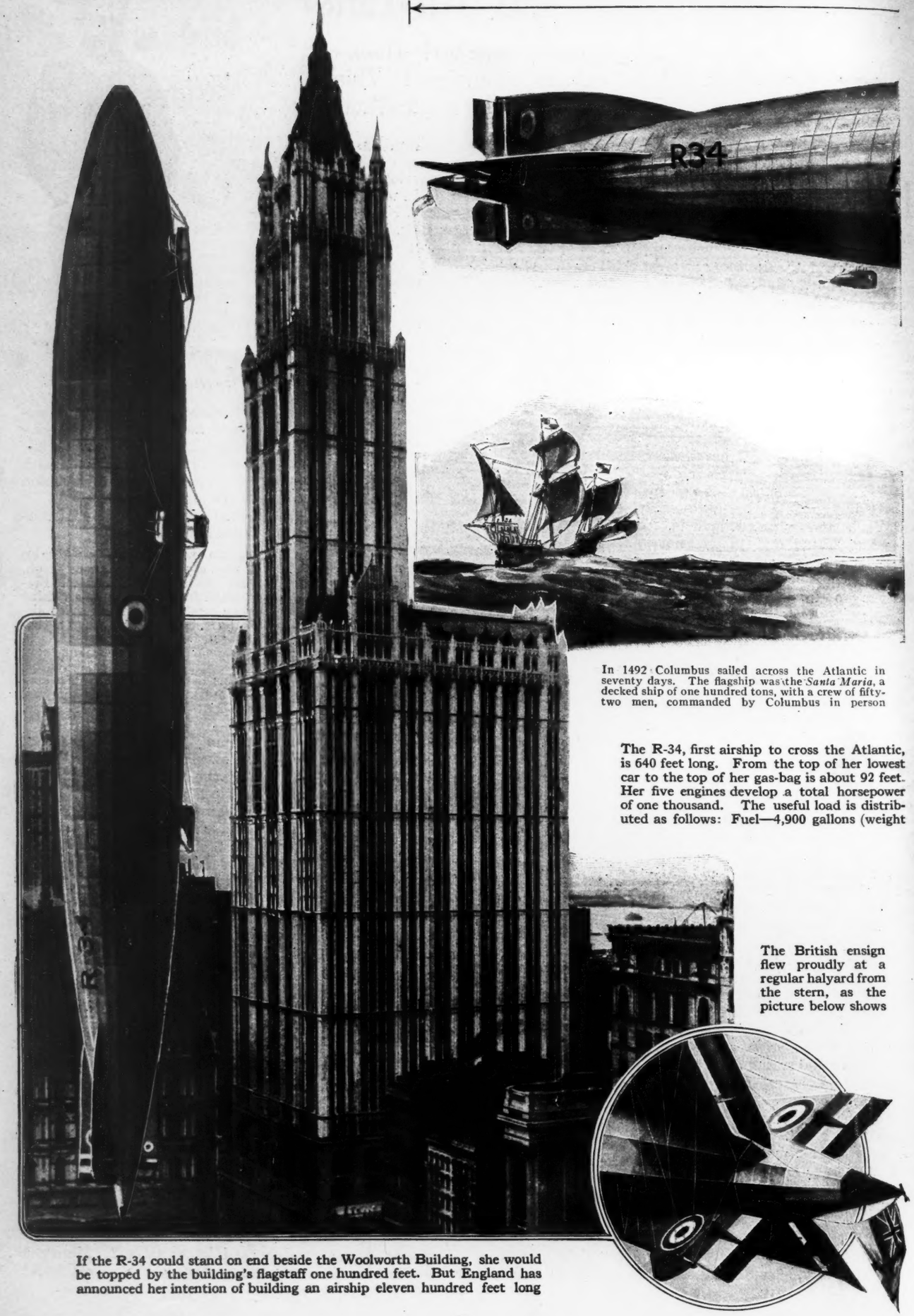
Up above you are eighteen hydrogen-gas compartments. Nine of them have automatic valves, which open when the pressure within them becomes too great. The other nine are equipped with hand valves. When the great craft rises, the hydrogen expands. To prevent the compartments from bursting—they are made of gold-beater's skin—the valves must be opened. But why both automatic valves and hand valves? Merely a precaution. Should the valves refuse

The First of Their Type

In 1492 Columbus sailed across the Atlantic in seventy days. The flagship was the *Santa Maria*, a decked ship of one hundred tons, with a crew of fifty-two men, commanded by Columbus in person

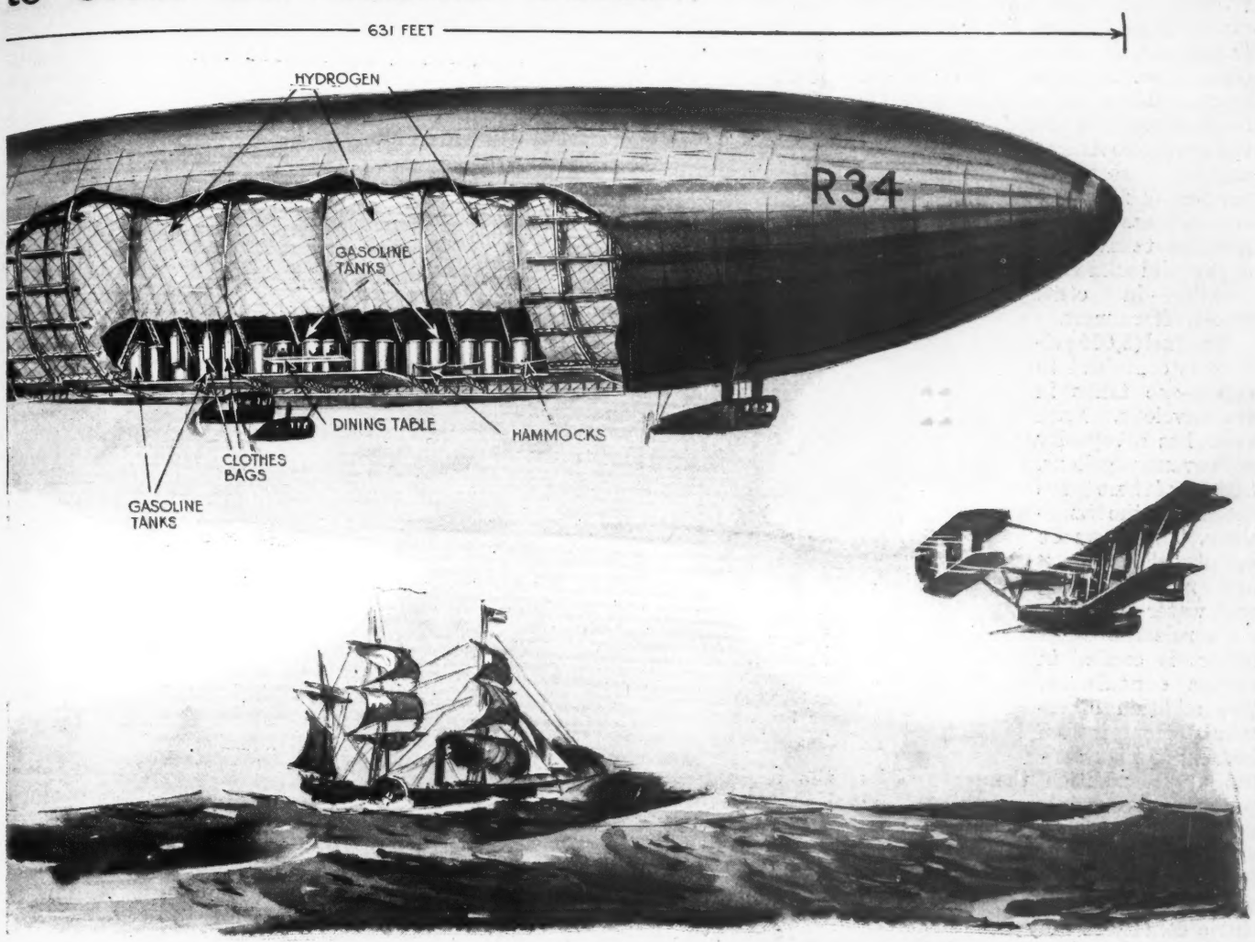
The R-34, first airship to cross the Atlantic, is 640 feet long. From the top of her lowest car to the top of her gas-bag is about 92 feet. Her five engines develop a total horsepower of one thousand. The useful load is distributed as follows: Fuel—4,900 gallons (weight

The British ensign flew proudly at a regular halyard from the stern, as the picture below shows



If the R-34 could stand on end beside the Woolworth Building, she would be topped by the building's flagstaff one hundred feet. But England has announced her intention of building an airship eleven hundred feet long

to Cross the Atlantic Ocean



The first steamship to cross the Atlantic, which was one hundred years ago last spring, was the *Savannah*. She was 130 feet long; her horsepower was only 90; her speed but 6 knots. It took her thirty-seven days to cross

The NC-4 has a wing span of 126 feet, almost as great as the *Savannah's* length. It took her about twenty-five hours to cross the Atlantic Ocean

35,300 pounds or 15.8 tons); oil—2,070 pounds (.9 tons); water—3 tons; crew and baggage—4 tons; spares—550 pounds; drinking water—800 pounds. The total is 24.32 tons. The R-34 had thirty-one souls aboard. The crew included two wireless operators, who had several sets of instruments at their disposal. The broken away section of the picture shows how comfortable the passage must have been. Good hammocks, hot food cooked on simple devices attached to the exhaust pipes of the engines—what more could be reasonably expected? The R-34 is a Zeppelin with a vengeance. The arrangement of cars, propellers, rudders, etc., is exactly like those of the large German Zeppelin L-49, which was captured in France intact and which was fully described in the Popular Science Monthly last year

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To reach the envelope from the forward car, you climb up an aluminum ladder through a pipelike passage. Felt shoes must be worn, lest you strike sparks from the rungs. The huge envelope contains eighteen compartments of explosive hydrogen. The vessel is as safe as a powder factory

The two cars in the middle, of which this is one, were not in danger of bumping while the ship was tethered near the ground, because they are higher than the cars at the end. These cars are all engine. Cylinders, flywheels, valve-gearing, and all else crowd the interior

to work, a fire might start and the crew might have to leap for life. Even flying over a warm city causes expansion. Over the cold sea the gas contracts. Thus, while flying over the ice-floes around Newfoundland, on the voyage to America, there was a contraction of forty per cent. Hence the final inflation takes place at the minimum temperature—in other words, after sunset.

The fuel (5,000 gallons) is contained in eighty-one tanks in the envelope. Each tank has a capacity of seventy gallons. Sixteen of these tanks are fixed to the framework. The others are called "slip tanks," and may be filled with water as ballast. As a rule the water ballast is carried in canvas containers. The addition of alcohol prevents it from freezing at high altitudes. In addition there are eight emergency containers, four forward and four aft. They carry, all told, about three thousand pounds of water, which is pumped in as the atmospheric conditions may demand.

The drinking water is drawn from three tanks. Besides these there is a reserve tank containing distilled water, which may be used in case there is a shortage of drinking water. On the way from England the men were limited to a pint of water at the end of each day.

Where do the men eat? Here in the dining-room, right in the center of the envelope, the only place where the cat's-walk is wide. But where are the tables? They are fastened on hinges to the framework. All the old naval class distinctions are swept aside; for the officers and men use the same dining-room—if room it can be called.

Hot Food for Dinner

The dining saloon is large enough to permit half of the crew at a time to eat. The food is cooked or heated, as it is wanted, on stoves attached to the exhaust pipes of the engines. Hence the engine-room serves as a kitchen. Chairs? There are none. The diners stand at a cupboard.

The meals are good. One day there was an excellent stew—the meat cooked just right, with potatoes and carrots, served on an aluminum plate with knives and forks, and, last but not least, one cup of fresh water.

Lieutenant Shotter says in his diary:

The mess cooks are now preparing the midday meal—cold roast beef, cold potatoes, bread, cheese, and chocolate. We were to have had beefsteak, but the two wing engines which are fitted with cookers are stopped for general adjustments, so we are taking cold lunch instead.

Later he writes:

Just had tea at four o'clock with General Maitland, Majors Scott and Cooke, and Lieutenant Harris.

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A cat was smuggled on board, for luck. Nearly every member of the crew had a mascot, from the engineer officer, who wore one of his wife's silk stockings around his neck, to Major Scott with his gold charm "Thumbs up"

The men in the gondolas are not cold. The cars are heated by the radiators of the motors.

The two side cars, just large enough for two men to do their work in, contain each one engine. Hence the engines are distributed as follows: one in the forward car, two in each of the central side cars, and two in the stern car. There are, however, only four propellers, the two engines at the stern having only one propeller. Two men work at the engines, one man operating and the other oiling.

At night searchlights in the neighborhood of New York swept the sky, to guide the R-34 as well as to find out whether she had arrived after sunset

General Maitland entered one day in his diary:

Slight trouble with starboard amidship engine—cracked cylinder water-jacket. Shotter, always equal to the occasion, made a quick and safe repair with a piece of copper sheeting, and the entire supply of the ship's chewing gum which had to be chewed by himself and the two engineers before being applied.

It was difficult for the crew to realize that they were on a transatlantic voyage. The trip was actually tiresome. Lieutenant Shotter, who is responsible for the performance of the engines, notes in his diary:

I am certain that passengers will be fearfully bored unless amusements are organized. One can see at the best only a vast expanse of sea, and at the worst fog, or an awfully downcast sky, which the Atlantic alone can bring. Our gramophone has been a God-send to us during mealtimes.

The men had exercise enough. Along the 600-foot "cat's-walk" they would run from end to end, a mile in the air. There are also steps in a vertical ladder to the top of the ship for those who are energetic or have duty up there.

How It Feels to Travel through Clouds

They saw little of the ocean through mist and clouds, having often a sea of clouds below and a sky of clouds above. What is it like to a true denizen of the air? Only the ocean traveler knows the cumulative effect of waking up, eating, going to sleep, and waking again day after day on the water. What must it feel like to become similarly a part of the atmosphere, to drive on and on with only clouds, stars, moon, sun, the blue sky, mists, and an occasional glimpse of the distant ocean below?

Officers and crew have sketched in words the charm and peril of their journey—sunset tints like paintings, magic mirages in the fog, phenomena that have never before been so thrillingly witnessed.

Groping in the Fog

The R-34 voyaged to these shores in a period of comparatively favorable weather; yet there were fogs over the north Atlantic, originating from icebergs or from chilly water flowing south from the Bering Straits. As the result of a series of curious meteorological circumstances, the R-34 had to stem temporarily strong contrary winds and several thunder storms. Her navigator complained of trying up and down currents, "bumps," near the end of the voyage. No wonder they should occur at the very edge of a memorable heat-wave. Such is the power of the engines that these difficulties were easily overcome.

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Hundreds of steel bottles containing compressed hydrogen gas were shipped to Mineola in order to inflate the gas-bags of the R-34

The lack of meteorologic knowledge was disconcerting. Lieutenant Harris, the weather observer of the R-34, remarked:

We learned that our old boat was as fickle as a bug, and insisted upon going over the high-pressure areas and plunging and diving through atmospheric changes. It took a good sailor to come over, and it will take sea-legs to get back. The task of navigating an airship is hard, because the air-currents are invariably invisible to the eye and must be sensed by delicate instruments and calculations.

They saw the Atlantic only a few times after they left the Irish coast. It was necessary for Cooke, the navigator, to use the clouds as a horizon to make his observations.

The cloud horizon is not clearly defined; the observer must guess a little as to the true line. Hence an error of fifty miles may occur because the observer has not guessed very well.

Shotter Sees His Double

By means of the shadow cast on the water, and also by special instruments, the navigator was able to measure the drift angle. Sometimes, when the R-34 plunged through the clouds, it was dark, cold, and wet. The windows had to be shut. Periodically the fog cleared away, so that the men on board could see the sea for a minute or two. Eyes smarted because of the bright light reflected from the fog.

The fog played some curious tricks. Read this from Lieutenant Shotter's diary:

Just had a shock. Opened the engine-room window. It is a large affair. Two men can lean out. I looked out and saw another engine-room opposite and a man's figure looking out. Ye gods! My heart beat frantically. Only the reflection from a bank of very thick white fog. We get extraordinary sights up here in this beastly fog—uncanny sights, I think.

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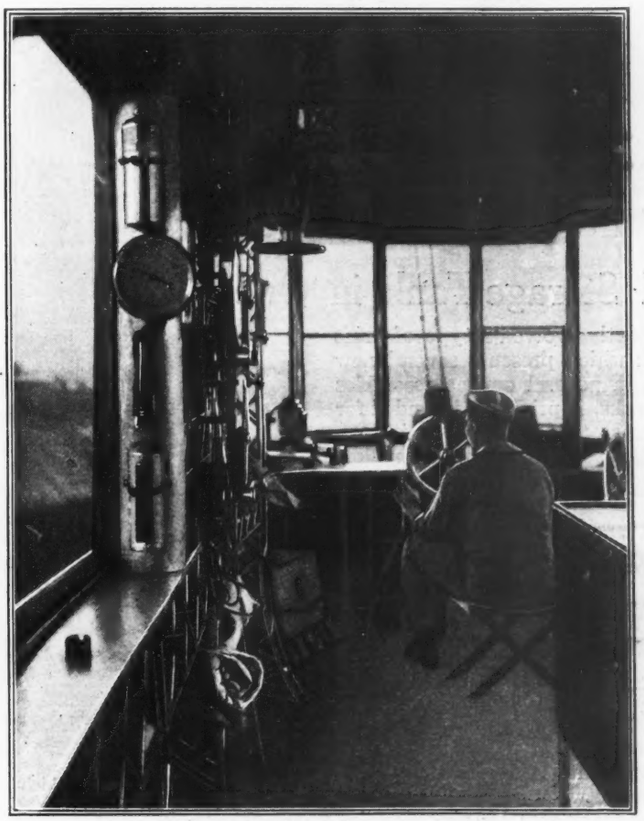
The field at Mineola was cluttered with pipes, joints, and paraphernalia of all kinds to refuel the R-34 and replenish her gas compartments

To escape the clouds above and below, Major Scott had to climb at times to an altitude of four thousand feet from two thousand feet. After the airship had passed into Fundy Bay, Scott turned east off his course to dodge a storm, putting on all engines. In this he was very successful. The R-34 passed through the outer edge of it.



It is no easy task to keep the mammoth dirigible on her course. Lieutenant-Commander Lansdowne, the American observer on board, did a two-hour trick at the wheel, and found it hard work

We had a very bad time indeed [says General Maitland] and it is quite the worst experience from a weather point of view that any of us have ever experienced in the air. During the storm some wonderful specimens of cumulo mamatus were seen and photographed.

General Maitland wrote constantly of fogs in his diary:

Suddenly we catch a glimpse of the sea through a hole in the clouds, and it is now easy to see we have a slight drift to the south, which is what was estimated by both Scott, the captain, and Cooke, the navigating officer. A few minutes later we find ourselves above the clouds, our height still being fifteen hundred feet, and beneath the cloudy sky are clouds at about eight thousand feet. We are, therefore, in between two layers of clouds, a condition which Alcock and Brown found themselves on more than one occasion on their recent flight from west to east.

There were remarkable rainbow effects on the clouds. One complete rainbow encircled the airship itself, and the other—a smaller one—encircled the shadow, both very vivid in their coloring. General Maitland writes:

To the west the clouds have lifted, and we see an extraordinarily interesting sky—black angry clouds giving place to clouds a gray mouse color, then a bright salmon-pink clear sky, changing lower down the horizon to darker clouds, with a rich golden lining as the sun sinks below the surface. The sea is not visible.

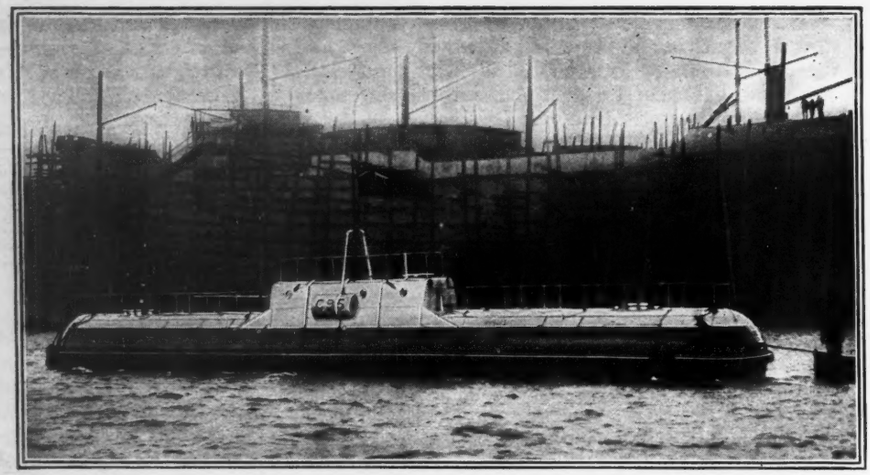
Still Larger Airships Are Coming

As the trip's slowness resulted partly from general eastward trend of North Atlantic weather, it follows that to cross from Europe to America an airship ought to navigate in the trade-wind regions or that an airship much larger and more powerful than the R-34 be employed. A dirigible's speed and reliability grow with size—a view which has often been expressed by Carl Dienstbach and which is now reinforced by General Maitland's announcement of an airship, now in course of construction, double the size of the R-34.

The commander of the R-34 kept in constant communication with our Weather Bureau during his brief stay. At the slightest indication of danger he would have slipped his mooring and floated away. As it was, the R-34 left at the urgent suggestion of the Weather Bureau. A storm was coming east from the Great Lakes, and the R-34 was in positive danger.

The voyage of the R-34 has strikingly demonstrated that Zeppelins must be navigated like sailing vessels, strictly in accordance with the winds, permanent or temporary. Even much faster Zeppelins—the British plan a hundred-mile-an-hour rigid dirigible—will pay commercially only if they follow the easiest route. They should cross from Europe on the Columbus course, aided by the trade-winds. The Antilles and possibly the Cape Verde Islands will serve as useful fuel stations.

We in America needed this demonstration of a Zeppelin's capabilities. We have been too skeptical, although our vast country is better suited for atmospheric cruises in giant airships than any European country west of Russia. That long period of gentle, quiet weather from June to October is ideal for air navigation.



The same new design used in this hundred-ton oil-carrier, recently built in England, may also be applied to craft having a capacity of twenty thousand tons

Oil-Carrier and Storage-Tank in One

BRITISH shipbuilders recently evolved a type of craft for carrying oil in bulk which presents several new features. This craft, which in general outline resembles one of the American whalebacks, is primarily intended for transporting oil in the overseas trade, delivering it to a shore line or to some craft afloat. The design also makes it possible, however, to use the craft as a stationary storage-tank for oil.

The craft shown in the picture above has a capacity of only one hundred tons of oil, but its underlying principles may be applied to much larger craft. Several having a capacity of twenty thousand tons of oil each have been designed.

The craft has a length of eighty-nine feet, a width of nine feet, and when loaded draws seven feet eight inches in salt water. The oil is carried in four hold compartments and two tanks between decks, which are placed at the fore and aft ends of the craft.

Each of the hold compartments is fitted with a sea valve operated from the space between decks. When the oil is removed from the compartments by the electrically driven pump, sea water flows in at the bottom through the sea valves. When oil is pumped into the compartments, it displaces the sea water, which is forced out through the valves. This arrangement makes it possible to maintain approximately the same waterline, regardless of the quantity of oil in the hold.

Electrical level-indicators installed in the different compartments, and a specially designed electrical steering arrangement which may be operated from the craft towing the oil-carrier, complete the equipment.

Is Your Shaving-Mug Sanitary?

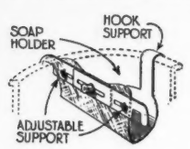
YOU may keep your shaving soap in a mug or in some other receptacle, but you must keep it somewhere. For the sake of convenience the container should be easily accessible and, for sanitary reasons, easily cleanable. All of these conditions are fulfilled in a convertible soap-holder invented by Ernest Hunold, of Providence, R. I.

The container is so simple of construction that the inventor, according to his own statement, had no difficulty in inventing and perfecting it in about two hours and a half.

Undoubtedly, the greatest advantage offered by this soap-holder is that it may be used with any mug, cup, glass, or can, and may quickly be detached for a thorough cleaning and sterilizing.

The metal holder consists of a semicircular flat base with an extension in the form of a hook-shaped clip which fits over the edge of the receptacle. At the opposite side the base is turned up at right angles, forming the support for two slidable arms.

This soap-holder, which may be used on any receptacle, is easily detached for cleaning



A Rumble-Seat for the Bicycle

THEY'RE off on a bicycle trip, father and child, the child fitting in a "shell" attached to father's rear wheel. This is the English version of the Indian papoose idea, father doing the lugging.

When the picture to the left was taken the family had just started on their trip; the baby was enjoying the scenery from his observation platform. And his father was not at all disturbed by his son's unbalancing weight.

The bicycle is kept from toppling by a supporting bar, attached to the side of the "shell." The bar is lowered when the bicycle comes to rest; and when the bicycle is moving the bar swings up into its place on the side of the shell.

Why let baby keep you from a bicycle trip? Carry him on the rear wheel

The father has left the bicycle long enough to make his child a cup of tea. Meanwhile a bar on the side of baby's "shell" is lowered to keep the bicycle from toppling over

Cooking in Camp

How to build and care for wood fires and the precautions necessary to make them safe

By Charles Coleman Stoddard

YOU know just how it is: you have pictured it in your imagination a thousand times. You gather a few bits of bark, dry moss, or leaves, snap up a pile of dry twigs (if you are wise you have plenty of both), or, if the woods are wet, you split a seasoned stick and whittle out shavings from the dry heartwood. You pile the kindling loosely over the tinder, lay on a few heavier sticks, and light your match.

So far, all is well. A flame leaps up as you touch off the dry stuff—then dies down into a smolder. You get down on your hands and knees and blow for all you are worth; and when you are out of breath, and your eyes are filled with smoke and ashes, you rise perspiring, about to give up in disgust. But while your back is turned a tiny flame has crept out from underneath, reaching upwards, leaping from twig to twig, and, lo and behold, you have it—the crackling, flashing camp-fire!

The Soul of the Camp

The camp-fire is the soul of the camp: it furnishes warmth, hot food, light, and protection. Its glowing circle holds back the damp and darkness, and builds a temporary home for you in the midst of the wilderness.

If your party is large, make it the duty of certain specified members to gather wood for the fire. This should be done in daylight. Clear a space in the open, away from tents and trees, and lay down a circle of stones, or dig up the earth and wet it down thoroughly. Provide, also, a number of logs or stones, at a comfortable distance from the fire, for seats. Pile up a rather large cribbing of light, dry wood with a quantity of tinder underneath; over this set the heavier sticks on end, forming a sort of loose wigwam or pyramid. As the fire burns down fresh wood can be added, and as the ends burn off the butts can be thrown on the fire.

Appoint or elect a leader to light the fire and to call upon each in turn to contribute to the evening's entertainment. Perhaps someone will bravely volunteer to toss a few flapjacks, or corn or potatoes can be roasted in the hot ashes. When "Good Night, Ladies" has been sung, pour water over the embers and make sure the fire is entirely out, unless you are using an all-night fire. This is very important, for if the wind should rise in the night, and the woods are dry, you might start a forest fire.

From the general run of camp pictures, one would think that cooking is the principal business of camping out—and it usually is for that member of the party who has experience in the preparation of camp dishes. With a few common-sense precautions a fire of ordinary proportions can be built as safely in the woods as in the open.

The Cooking Fire

The proper fire for cooking is a small one. You will have a good draft if you place it near the base of a large tree—but *don't* build it against the tree, or you will kill the tree.

The author knows how to get the best draft and heat from a small fire

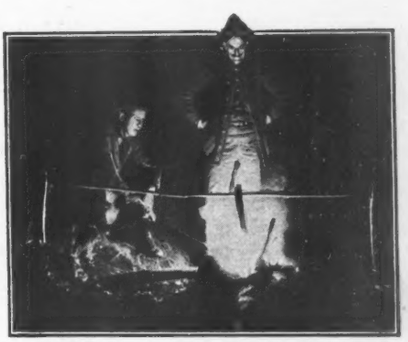
First, clear the ground of all brush for some distance in a circle around the fire. In very dry weather, dig up the leaf mold with an ax and pour in a few buckets of water. In winter, clear the ground of snow, or you will soon find yourself in a lake of slush. Your snow-shoes will make excellent shovels if the snow is not crusted. If it is, break it up with the ax and chop well into the frozen ground.

Provide an abundance of kindling. After the small fire is well started and the ground warm beneath it, it will burn almost anything. The two things that a camp fire requires and must have are fuel and air. Don't throw on the sticks any old way, so that the air cannot draw from underneath and upward through the mass, and don't stir the fire continually so that you break it up. If you want a large bed of coals quickly, lay on a considerable amount of wood and let it burn down altogether. Hardwood is necessary for this purpose. If wood is green or damp, a split edge will generally take fire more quickly, and it is well to set the sticks on end. This increases the draft, and the outer part of the wood will dry off while the inner side is burning. For a slow fire, and for the night fire, lay the sticks horizontally and all the same way.

For the cooking fireplace, take two green logs about six inches in diameter and three or four feet long, leveling off their tops with an ax (or use large flat stones if you have them). Lay these parallel, slightly closer together at one end than the other, and far enough apart so that your cook-pots will set squarely upon them. Dig out a little trench between them, and at the narrow end build your fire. Over the blazing wood set the pots to boil, and as coals form rake them forward to the other end of the trench for frying and broiling. Never attempt to broil or fry over a blazing fire: set the pan directly upon the glowing coals. When cooking over a large fire, draw a pile of coals to one side and remove all the unburnt smoking wood. You can then cook in comfort, without roasting yourself and without danger of burning the food.

Roasting and Baking

If you are to attempt roasting meat, or baking with the reflecting baker, build the fireplace in front of and parallel to the face of a large boulder, or set up a fireback of logs to throw the heat of the fire forward.



Hang your cooking-pots over the fire on a green stick as shown

To roast meat or game, suspend it before the fire on a wire, which, in turn, is hung from a high branch with a piece of strong cord that will twist

and consequently keep the meat constantly turning. Underneath set a drip-pan partly filled with hot water, and baste the meat frequently to prevent its burning and to provide gravy.

Often you will want to suspend your cook-pots over the fire. Your own ingenuity will suggest many ways of doing this. The simplest form of crane is the "tea-stick"—a long green pole slanting above the fire, its butt thrust under a stone or log, and the tip from which the kettle is suspended held above the fire by another stone or crotched stick.

For your permanent camp, set up strong crotched sticks, about four feet long, at either end of your trench

Eat? Why, you are hungry enough to eat a wool blanket, and the woods did it

fire, and across these lay a long "lug pole." On this you can use the wire pot-hangers, or cut several crotched sticks, leaving one leg from one to two feet long. At the inner side of this longer leg cut a deep notch for the bail of the kettle. By having sticks of varying length you can secure almost any degree of heat, or the pot may be hung to one side and kept hot indefinitely.

At all times bear in mind the virtues of the small fire: easy to build, easy to control, and *easy to put out.* A little fire is all that is needed, and the work that it will do, with practice, is amazing.

The Quick, Hot Fire

When you come in from fishing or tramping you are in no humor to swing an ax and drag up logs. Break a few handfuls of dry sticks, none bigger than your thumb, and set them all blazing briskly at once. By the time the kettle has boiled, you have ample coals for frying or broiling. If your menu is more elaborate, provide a few extra sticks.

While you eat your meal set on another pot of water to heat, and as you finish with each dish wash it. When the meal is over and the pipe smoked, pour the dish water over the smoldering embers—and you are ready for the sandman's coming.

When going into a more or less permanent camp, even in fine weather, it is well to take the time to prepare a quantity of this small wood—enough for several meals—beforehand. Split the larger sticks through once or twice with the belt-ax, and, mixing about equal quantities of hard and soft wood, tie it up with string or strips of bark into bundles six inches or so in diameter. These can be thrown in along the sod-cloth with the other duffle. When meal-time comes, all you need to do is to open a bundle, throw a few sticks on the fire—fan the smoking coals, and you have a blaze. If it rains in the night and douses your fire, you can laugh defiance, for you have dry wood to cook breakfast over. Such a small fire can be built safely just under the outer edge of the tent, and you can live in comfort until the rain clouds have passed.

By all means, if only for companionship, have a fire at night, but don't burn wood simply because it is abundant. The night fire has another use besides warmth, though happily not necessary now in the greater part of this country. Where dangerous animals abound, it is the custom to build extra fires, sometimes a circle of them, about the camp, to ward them off. Either because of the light of the blaze or the odor of the smoke, very few wild animals will approach a fire, or even smoldering coals.

Watch Your Fire

There are numberless precepts of the camp fire. The first of these is carefulness, and the rest mean exactly the same thing. The careless camper comes—and goes, leaving a trail of destruction behind him. Of 7,814 fires fought by foresters in the national forests in a single year, 5,682 were preventable and caused by human agency; 1,288 of these were caused by campers. The great Minnesota fire of October, 1918, caused by negligence in starting fires to clear land and failure to control them, completely destroyed 200,000 acres of timberland and burned over 400,000 acres more, causing a loss of approximately $25,000,000. Swept by a sixty-mile gale, it destroyed sixteen towns and villages, including Cloquet, a city of 10,000 people, burned more than 5,000 homes, and cost 432 lives.*

Every part of the woods is inflammable, from the leaf mold under our feet to the top of the tallest tree. When you build a fire in your home, you build it in a proper container. You would not think of building it upon a barn floor or in the midst of a pile of litter; why then build it, without thought or preparation, where you risk the destruction of the forest canopy that has taken centuries to build?

A fire in the woods must always be carefully built; it must be watched constantly at all times, and never left, even for a short time, without being extinguished. If it gets beyond your control, you have no neighbors to summon, no fire department to come to your aid.

*Editor's Note—These figures are official and were secured from the National and State Foresters.

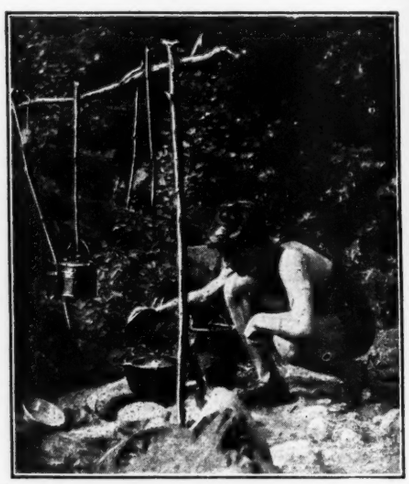
Acquaint yourself with the laws of your State regarding forest fires before you go into the woods. If it is necessary to have a permit to build a fire, secure it. Remember it's not a matter of sentiment, a matter of whim or the selfish interest of a few sportsmen, that requires you to take every precaution to extinguish your fire thoroughly when you break camp. The State and national laws are very simple and explicit, and provide severe penalties, not alone for carelessness with fires, but also for removing or defacing any fire notice. No warrant is needed for arrest.

Never build a larger fire than necessary. Never build it against leaves, rotten wood, or other material that is likely to spread it, or against stumps, or large or hollow logs, where it is difficult to put out. In windy weather, build it in a depression or surround it with a wall of rocks, and clear the ground for a wide space all around.

Every person who goes into the woods should realize the danger of fire, and recognize his personal responsibility, not alone in guarding his own fire, but in laying aside every other plan to assist in fighting an accidental fire.

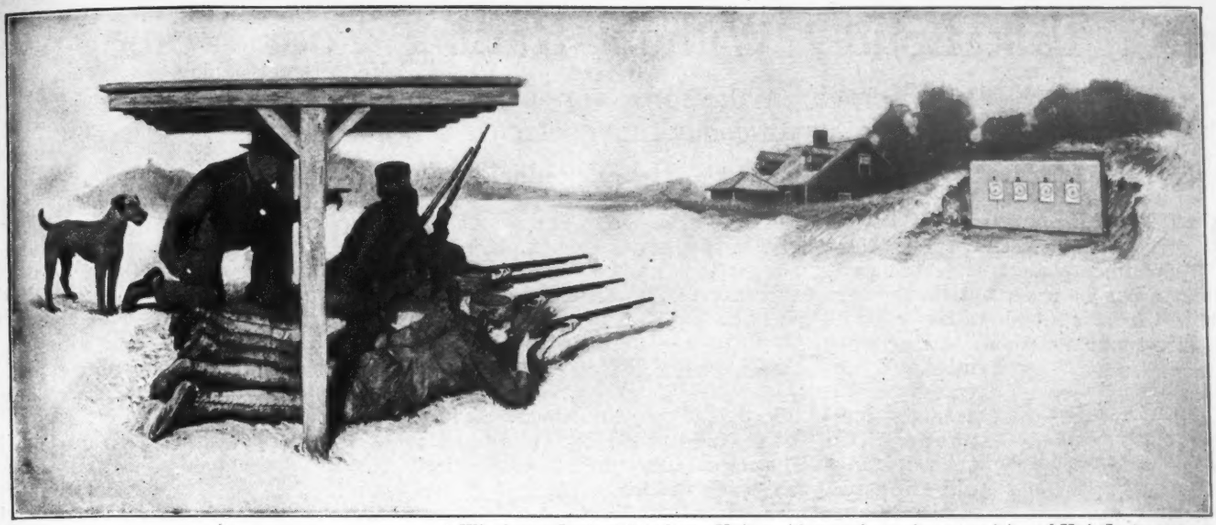
In justice it should be stated that it is not the sportsmen and experienced campers generally who are at fault. It is the thoughtless "man from town," the picnicker, and the casual camper, who cause the greatest damage.

A caution to the sportsman who smokes. Never, in the excitement of the moment, light your tobacco and toss the burning match into leaves or



Build the fire in the shade. Cooking is hot enough work without the sun

dead grass, and never drop the glowing heel of your pipe or a cigar stump without grinding it deeply into the earth. Try breaking every match between the first and second fingers with the thumb of the same hand before throwing it down. We are only human. A single encounter with a glowing match-head, and we have learned carefulness—the most important lesson of the woods—forever.



A Winchester Junior Rifle Corps Unit at rifle practice under supervision of Unit Instructor.

A rifle range that any boy can build

Sharpshooter Medal

WHERE to shoot—is that the problem that has kept you from joining the Winchester Junior Rifle Corps and learning the joy of trigger magic? If so, a few practical hints are all you need to rig up a rifle range of your own, where shooting can be made safe. The most important thing is to select a backstop that will catch and hold the bullets. Every shot must be safe.

The side of a hill (as in the picture) makes the best backstop for a range. Dig it out square and face it with light boards to hold your paper targets. If there's no hill available, you can build a backstop in your yard. A large packing case filled with sand or earth will be safe, but any backstop should be at least 4 feet high and 4 feet wide.

If your cellar or basement will give you a clear range of 50 feet, it will make a fine place for shooting all the year 'round, and in all kinds of weather. Here you can make a plain backstop as suggested above.

Start a W. J. R. C. Unit with your friends

The job of finding a place to shoot, rigging up a range and getting your rifles is always easier and cheaper *when you have a bunch of your chums in on it.* There's more fun, too, in the actual shooting when there are other fellows to compete with.

So why not get together with half a dozen of your chums, join the Winchester Junior Rifle Corps and organize a regular Unit which will be officially recognized by National Headquarters? Any boy who starts a Unit receives a Special Service Pin.

The W.J.R.C. will help you from start to finish in rigging up an indoor or outdoor range.

The W.J.R.C. gives you all the instruction necessary to become a real expert in the use of a rifle. It provides for officers, supervisors and adult instructors to make your shooting safe.

It costs you nothing to join the W.J.R.C.. There are no dues and no military obligations. The W.J.R.C. was organized solely to encourage better marksmanship and better sportsmanship among boys and girls of America. It is intended to develop the qualities of fair play and manliness which are essential to success in after life. Any boy or girl not over 18, who is in good standing in his or her community, is eligible.

Membership in the W.J.R.C. covers the entire United States. There is hardly a town now that has not at least a small Unit of the big National Organization where boys are competing for the famous Winchester Marksman, Sharpshooter and Expert Rifleman Medals. You, too, can earn these trophies of marksmanship if you join the W.J.R.C. and start shooting now.

Get the official plan and rule book

Write today for the Winchester Junior Rifle Corps "Plan for organizing a W.J.R.C. Unit," and for the official rule book "How to handle a rifle safely." This booklet tells you all about the W.J.R.C. and describes in detail the fine points of shooting—alignment of sights, the three correct positions, rules for gun safety, the care of rifles, and the proper rifle for you to use.

If you are a boy scout or a member of any other boys' organization, state what organization and give the name of the official in charge.

National Headquarters

Winchester Junior Rifle Corps

275 Winchester Ave., New Haven, Conn., U.S.A.

Division 920

Standard types of .22 caliber Winchester Rifles, popular with members of the Winchester Junior Rifle Corps

WINCHESTER *MODEL 90. Take-down repeating .22 caliber rifle, 24-inch octagon barrel. The standard target rifle for over 25 years.*

WINCHESTER *Take-down .22 caliber single shot rifle. A low priced, light weight gun made in two sizes..*

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Winchester Junior Rifle Corps
National Headquarters,
275 Winchester Ave., New Haven, Conn., U. S. A. Division 920

Gentlemen:

Please register my name as a member of the Winchester Junior Rifle Corps, and send me a membership button and certificate of membership. Also tell me how to organize a local Unit of the W. J. R. C.

Very truly yours,

Name _____

Street Address _____

City _____ *State* _____

Talk Loudly Without Raising Your Voice

You can make some very interesting experiments with easily made electrical apparatus

By Henry Stedfield

LOUD talking apparatus is one of the most interesting forms of experimental electricity. The apparatus can be used to talk through show windows (loud talker outside in street and salesman talking into microphone transmitter); as a detectophone; for transmitting phonograph music from one room to another; as a radio amplifier; as a telephone extension (by placing the regular telephone receiver against that of the telephone transmitter) and many other uses which will suggest themselves to the experimenter.

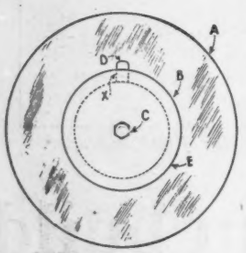


Fig. 1

A thin carbon diaphragm is used in the interior mechanism

The transmitter is highly sensitive. The shell of a watch-case telephone receiver makes an excellent outer case as indicated at *P* in Fig. 3. For the interior mechanism we need a thin carbon diaphragm *A* (Figs. 1, 2 and 3) preferably standard size —2⅛ in. wide and 1/64 in. thick. A felt washer *E* 1¼ in. in diameter with walls 3/16 in. square should be made. This washer should be made with a tongue *X* 3/16 in. long. Glue the washer to the center of the carbon diaphragm.

Fig 2

Another carbon button 1¼ in. wide and about ⅛ in. or 3/16 in. thick is made. The thinner it is the more sensitive the apparatus will be. A hole large enough for a ¼-in. screw is bored through the center of the carbon button. Countersink the hole a little on one side so that when a ¼-in. bolt, ½ in. long, and nut are bolted on this button, the head of the bolt will not touch the carbon diaphragm, Fig. 2. The carbon button can be easily made with a hack saw and the hole bored with an iron bit.

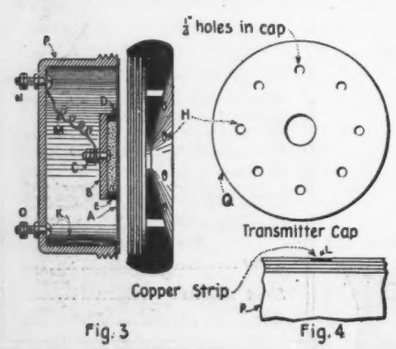


Fig. 3 Fig. 4

The transmitter in detail. Here lies the secret of the loud talker

Insulate Bolt with Shellac

It is better to insulate the head of the bolt *S* by dipping it in shellac. The carbon button must now be glued to the felt washer with the head of the bolt and the beveled side of the carbon inside, see Fig. 2. After the glue is dry, the chamber between the two carbons should be loosely filled with polished carbon grains or balls. They must never be packed tightly, but should fill the space entirely. Do not touch the carbon grains with the hands, as the natural oil from the hands destroys their sensitiveness. It It is much better for the experimenter to buy these carbon grains from an electrical supply house than to attempt to make them.

A piece of paper bent to a sharp scoop will simplify the filling of the chamber. The openings between the ends of the washer must be plugged with a piece of felt *D*, Figs. 1 and 2. This can be done with a pin or sharp pointed knife.

Making Connections

The binding-posts, *N* and *O*, Fig. 3, are fastened on the bottom of the transmitter. The connection from one of the binding-posts to the carbon diaphragm should be made with very thin copper or brass strips, ⅜ in. wide and about 1½ in. long, as shown at *K*, Fig. 3. The copper strip is bent over the edge of the shell and cut off flush at the edge of the rim *L*, Figs. 3 and 4.

Do not place the carbon diaphragm with its parts over the strip, as the strip, being higher than the rim of the shell, would crack the diaphragm when the cap is screwed down. For that reason, by means of a small file or knife, make a cut in the rim of the shell at *L*. This slot must be exactly the thickness of the copper strip, so that when the strip is put in the slot, the top lies flush with the rim of the receiver shell. The other terminal *N* should be connected by three No. 28 insulated copper wires to the terminal *C* of the carbon button. The three small wires have more flexibility than one large wire. The carbon diaphragm should now be put in place, and a receiver cap screwed on the transmitter as shown in Fig. 3. The transmitter will be more sensitive if a number of ¼-in. holes are bored in the cap as shown in Fig. 4.

Any watch-case receiver can be used. The double-pole type is more efficient, but it is easier to make the receiver from a single-pole type. First remove the permanent magnets from the receiver, then take out the spools of wire and its soft iron core. Another coil of heavy wire *Y* must be wound over the core *Z* in Fig. 5 in place of the fine wire. One hundred and fifty feet of No. 24 enameled or cotton insulated wire is about right, as this will give 5 ohms resistance. Give this coil a coat of shellac to hold the wires in place; then bolt the electromagnet back in its original position. The connections should be made from the magnet to binding-posts on the back of the receiver.

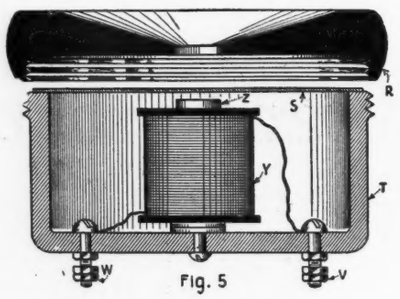
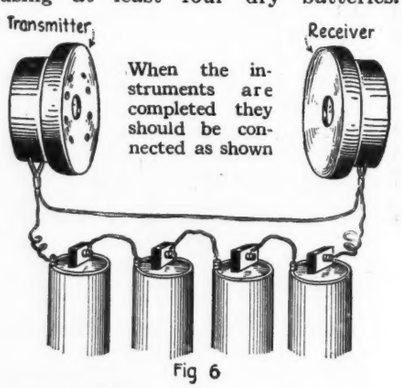


Fig. 5

Another coil of heavy wire, *Y*, must be wound over the core *Z*

Completed Instruments

The instruments are now complete, and should be connected as in Fig. 6 using at least four dry batteries.



When the instruments are completed they should be connected as shown

Fig 6

Talk in a moderate tone into the transmitter and the receiver will talk very loudly and distinctly, the voice being heard clearly a long way off. It is important that all connections be made as tightly as possible. The apparatus can be used as a marvelously sensitive detectophone. Put the transmitter back of a picture, and run the wire to an adjoining room, and you can become a detective.

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Get a box of The Black Shells from your dealer. Shoot them—in the field or at the traps. If you don't like them, get your money back.

Just take the unused part of the box back to your dealer. We authorize him to refund to you at our expense the price of the whole box with absolutely no question or quibble.

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Have you tried our 22 N. R. A. Long Rifle Lesmok Cartridges? They are as accurate at 250 yards as the larger calibers are at 1,000. Made with solid lead and hollow point bullets. Cost no more than other cartridges of same size and style. Send for circular C93.

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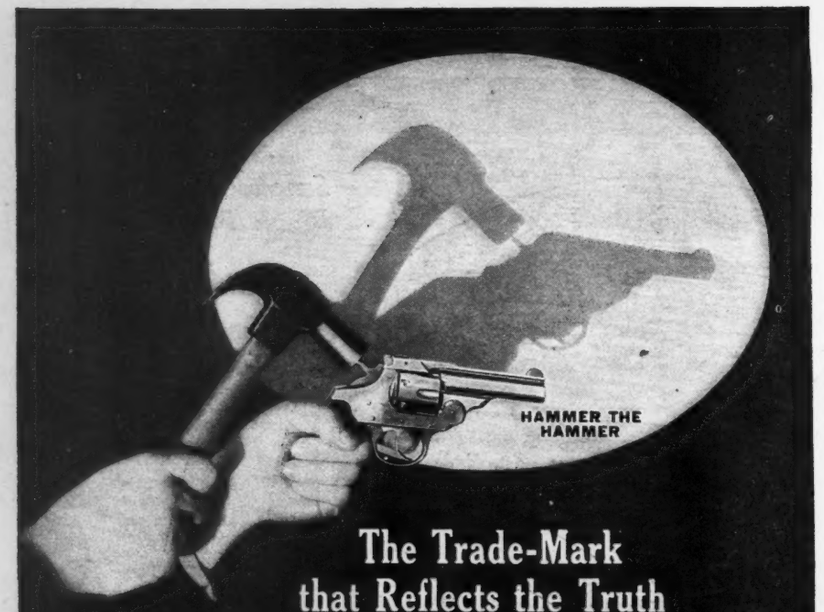

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This picture tells the story of Iver Johnson safety.

The Iver Johnson is known the world over as the revolver that can't go off by accident. Drop it, throw it, or "Hammer the Hammer"—it won't go off. Just one way to discharge an Iver Johnson—pull the trigger *all* the way back.

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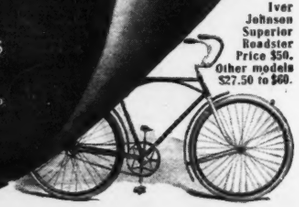
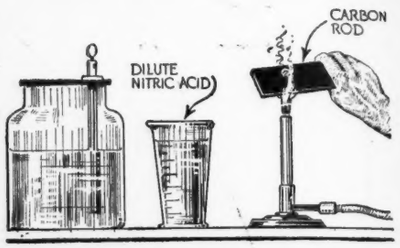


How to Prevent Polarization in Sal Ammoniac Cells

AVERY simple but equally effective method of preventing the output of sal ammoniac cells from rapidly diminishing is as follows: Dip the carbon rod of the cell in dilute nitric



When wet batteries run down quickly there's a reason for it

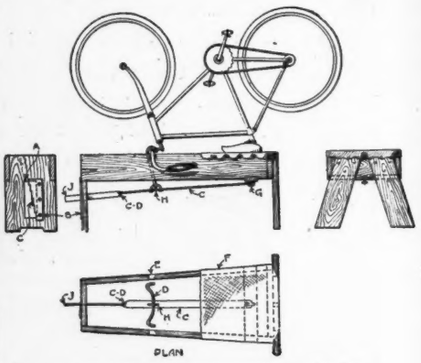
acid and heat for a few moments in a gas flame. The occasional repetition of this treatment will increase to a remarkable degree the output of current from the cell.

The rapid falling off of current in such cells is due to the formation of a non-conducting sheath of hydrogen gas about the carbon rod. The above treatment will dispose of the hydrogen and prevent the polarization.—FLOYD L. DARROW.

To Repair that Broken-Down Bicycle

AN INVERTED bicycle is an unsteady thing at the best, and when in this position for repairs can behave in a most exasperating manner. Here is a stand that will tame it down and make it much more tractable.

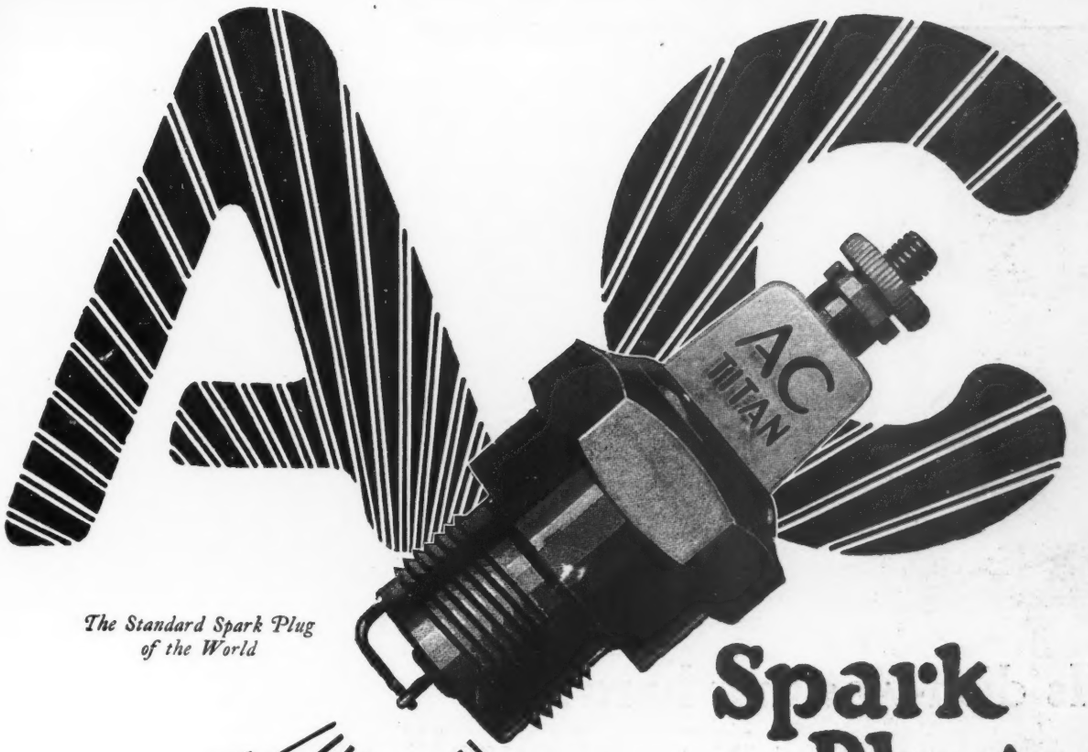
The bicycle is held upside down so that the wheels and other parts most



A repair stand that clamps the bicycle steady while it is being fixed

liable to need overhauling are free and far enough from the floor to avoid the necessity of stooping over to work upon them. The saddle cannot be marred as it rests upon gunny sacking, and the spring steel bar with tongs holds the handlebars firmly but may be instantly released by a slight pressure of the foot.

Bicycles vary as to length of wheelbase and distance between saddle and handlebars. This is allowed for by making the gunny sack covering about



The Standard Spark Plug of the World

Spark Plugs

They Have Always Met the Emergency

If you could get a composite expression on spark plug merit from the Society of Automotive Engineers it would be the highest tribute that could possibly be paid to AC.

For these automotive engineers know spark plugs. They know that throughout the history of the motor car industry there has always been an AC Spark Plug ready to meet each new engineering problem.

That is why the majority of manufacturers of high-grade motor cars have been using AC Spark Plugs for standard equipment year after year.

When the Government sought a reliable spark plug for aircraft service, army engineers submitted their problems to all spark plug makers.

What was the result?

AC's were selected as standard equipment on all Liberty and Hispano-Suiza Airplane Motors.

Here again AC met the emergency.

That's about all you need know about spark plugs.

You may be sure that the spark plugs which have met the exactions of these master engineers will serve you unfailingly also.

Champion Ignition Company, FLINT, *Michigan*

These manufacturers use AC Spark Plugs for factory equipment

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Acme Trucks
Advance-Rumely Tractors
Ahrens Fox Fire Trucks
American-La France
American Trucks
Anderson
Apperson
Appleton Tractors
Auburn
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Beck-Hawkeye Trucks
Betz Trucks
Brockway Trucks
Buffalo Motors
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Diehl Trucks
Dodge Brothers
Dort
Duesenberg Motors
Eagle Tractors
Essex
Federal Trucks
Frontmobile
F-W-D Trucks
Gabriel Trucks
Genco Light
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G. M. C. Trucks
Gramm-Bernstein Trucks
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Riker Trucks
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Rock Falls
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Sandow Trucks
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Smith Motor Wheel
Standard "8"
Standard Trucks
Stearns-Knight
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Sterling Engines
Sterling Motors
Sterling Trucks
Stewart Trucks
Straubel Engines
Sullivan Trucks
Swartz Lighting Plants
S-S-E-Co.
Tiffen Trucks
Titan Trucks
Tower Trucks
Trego Motors
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Veerac Motors
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U. S. Pat. No. 1,135,727, April 13, 1915. U. S. Pat. No. 1,216,139, Feb. 13, 1917. Other Patents Pending.

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ADDRESS

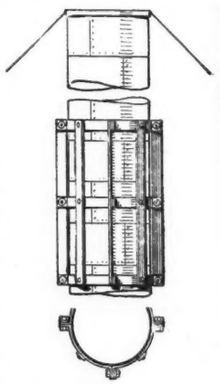
18 ins. long. The frame is of any thickness wood, approximately 3 ft. long by 1 ft. wide at the front, and 1½ ft. at the rear, supported by legs so that the top is 1½ ft. from the floor.

In the front leg an opening is cut 3 ins. wide by about 8 ins. long (*A* in diagram). To one side of this is secured a piece of iron *B*, broader at the top than at the bottom, and saw toothed. *C* is a flat iron bar about 2½ ft. long by 1 in. or 1¼ in. wide, twisted at *D*, swung on pivot *G*, and extending through the opening *A D* is small round iron bar with claw ends, pivoted to the flat bar at *H*.

To operate, place bicycle upside-down, with the saddle resting upon the gunny sacking *F* and handlebars through notches *E*. Place claws *D* over handlebars to either side of center post. With foot at *J* press down spring bar *C* until the claws hold the handlebars tight, and secure by catching the bar in one of the notches in the flat iron plate.—SAMUEL W. BEACH.

Repairing an Unsteady Smokestack

SHEET-IRON smokestacks frequently become weakened and thin about half way to the top, due to vibration and other causes. This often happens while the upper and lower halves of the stack are still in excellent condition. To insert two or more new sections in the center of the stack is an expensive and difficult proceeding. And to patch a defect is almost as bad as putting in new sections.

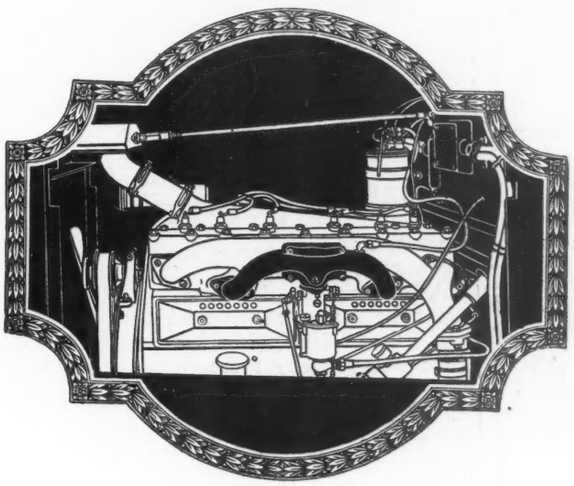


The chimney brace is firmly bolted around the stack and wired to the roof carefully

There is a way, however, to do the repairing with but little expense for new material and time taken. The repair consists of a framework of flat, wrought-iron bars, bolted around the pipe in such a way that it will brace up the weakened portions. The frame-work should be long enough to reach several feet beyond the weakened section in either direction and should be bolted firmly on the outside of the stack.

The brace consists of three rings of flat bar iron connected by several upright bars of the same material. It is made in halves upon the ground and then hoisted into position and bolted together.

This brace should fit the stack snugly and the two halves should be drawn as tightly as possible. The method is equally good on small or large chimneys, and, being simple and cheap repair, should commend itself to repair men.—DAVID BAXTER.



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The gasoline is to blame. It cannot be consumed by the engine. It is the wrong kind of gasoline. The right kind, the kind that the engine will burn completely, is too scarce, too expensive for general use.

There is only one way out of the difficulty. That is to design the engine so that it will burn the kind of gasoline generally obtainable.

For two years the Chalmers engineers have been at work on this problem. After much research and countless tests they have at last produced the ideal automobile engine.

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The Chalmers engineers have gone further. In addition to providing the manifold with a Hot Spot, they have given the manifold a Ram's-horn shape, so that it is free from the sharp angles that check the onward flow of the swiftly moving mixture to the cylinders. The curves are easy.

Each cylinder, therefore, receives exactly the right amount of mixture. One cylinder is not starved and another surfeited —the usual way.

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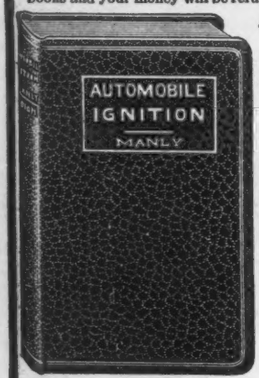

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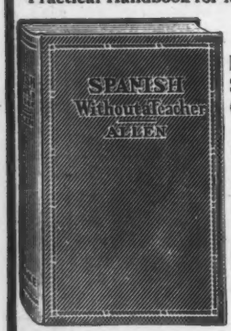

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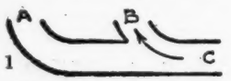
The How and Why of a Carburetor

By S. E. Gibbs

DURING the last few months we have heard much about the scarcity and high cost of gasoline. At times the situation really looked critical, but recent developments have cleared the way, at least for the present. The oil chemists have devised processes whereby more gasoline can be obtained from the crude oils. The engine and carburetor designers have perfected designs that use lower grade fuels and give more power per gallon of fuel used. The car owners are becoming more familiar with their machines and are able to get a greater mileage from the fuel that they use.



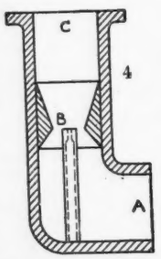
Manifold connections

There are many new carburetors and fuel-saving devices on the market today. Before any of these can be discussed in an intelligent manner one must get the fundamental principles of the carburetor clearly in mind.

A carburetor may be defined as a device for vaporizing the fuel and mixing it with the proper amount of air for combustion in an internal-combustion engine. From this definition it is evident that the requirements of the carburetor are two-fold.

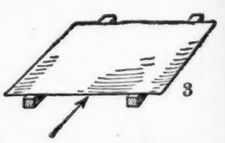
Vaporization of the fuel is very important and has become more so with the use of the low-grade fuels, which are hard to dissipate into a vapor. Several distinct reasons can be cited as to why complete vaporization is so necessary.

If an engine is to run smoothly the explosions must be equal in all of the cylinders, and to ensure this equal charges must be delivered to each cylinder. This cannot be done unless the fuel is completely vaporized, as may be clearly seen from the example given in Fig. 1. The openings *A* and *B* represent the connections of the inlet manifold to two adjoining cylinders, and *C* a connection to the main part of the manifold leading from the carburetor. If the inlet valve at *B* is open the charge is being drawn in through *C* and is entering the cylinder at *B*. Now if the fuel is not completely vaporized, or is partially carried along as small drops, the heavy portion will have more momentum than the air and fuel vapor, and will tend to go straight ahead, just as an automobile does on a corner, and into the passage toward *A*. Therefore not enough fuel would enter the cylinder at *B*, and the mixture would be weak and probably the cylinder would not fire. Inversely, the charge taken in through *A* would be the normal mixture plus that which was carried past *B*, and would be too rich. This explains why a motor misses when starting on a cold morning.



How the mixture enters the cylinder

If the fuel is taken into the cylinder as a liquid, part of it will be deposited on the piston head and cylinder walls. The part of it that strikes the walls will mix with the lubrication oil and make the oil thin and interfere with its lubricating properties. Part of this oil and gasoline will get by the piston and into the crank-case and thin the oil in the sump. In some cases this takes place to such an extent that the amount of fuel that enters the sump is more than the amount of oil that is used and it seems the engine is using no oil. This is very dangerous and the oil should be drained and a fresh supply added often until the difficulty is remedied. The oil that remains in the cylinder partially burns and leaves a heavy deposit of carbon, which will in time cause the motor to knock and necessitate its being dismantled for the removal of the carbon.



Device for experimenting

Rapid and complete combustion must be had if the engine is to develop maximum power with a minimum of fuel. Manifestly no power is obtained from fuel which is not burned. The gasoline must be completely vaporized and well mixed if it is to burn properly. Then no carbon deposits will be left from the fuel but carbon can still be formed from an over supply of oil reaching the cylinders or from the dust which is drawn into the cylinders.

Complete vaporization is attained and maintained in two ways; namely, first by spraying the fuel and breaking it up so that a large surface is exposed

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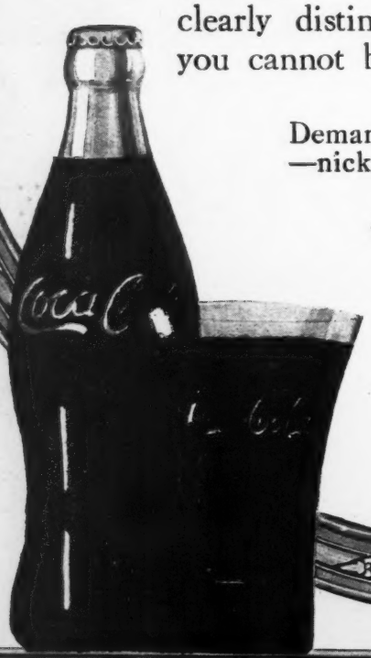
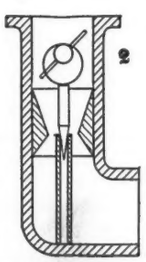


Sold Everywhere

to the air, and second, by heating the fuel or air. Heating may be accomplished in several ways. The fuel could be heated but not enough heat can be stored in it to give good results. Normally a carburetor becomes cold due to the heat absorbed from the metal when the fuel vaporizes; this must be counteracted. The air which is to be taken into the carburetor is often passed around the exhaust pipe and heated enough to vaporize the fuel. The intake manifold is often heated by passing hot water around it, and in this way the fuel is prevented from cooling and condensing, and any drops of fuel which strike the manifold wall are quickly vaporized. However, only sufficient heat should be applied to get complete vaporization, as additional heating will lower the maximum power the engine will develop and may cause pre-ignition.

The fuel is sprayed through a small opening or jet and is thus broken into small drops. This process can be made more effective by increasing the suction on the jet and thereby making it possible to deliver the fuel through a smaller jet. A venturi tube is used for this purpose in most designs. A cross section of the choke tube is shown in the sketch number 2. The air enters at *A* and flows through the small openings at *B* and out to the engine through the passage *C*. The air will be caused to flow at high velocity at the narrowest passage through the venturi tube. As the velocity increases the pressure decreases so the suction on the jet will be increased by speeding up the air in this manner. It may be rather hard for some to conceive the phenomenon of the suction increasing. The experiment shown in sketch number 3 may make this point clearer. Take two pieces of wood, 1 in. square and 10 in. long, and lay them on a table about 6 in. apart. Then lay a sheet of paper across them and blow beneath the paper. The suction caused by the moving air will draw the paper down to the table.

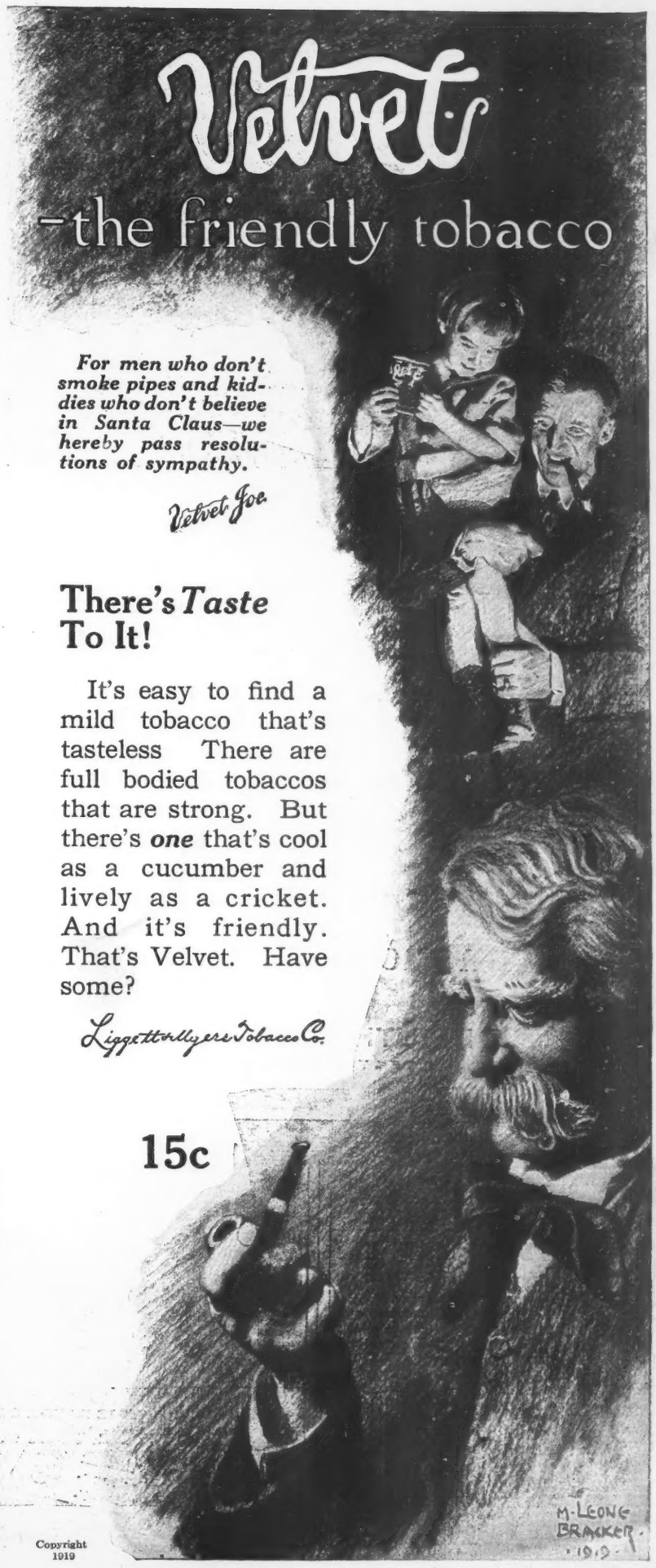


The throttle regulates the richness of the mixture

When a device for vaporizing the fuel has been obtained the work is only half done as the fuel must be mixed with the correct amount of air before it is ready to be taken into the engine. There should be 12 to 15 parts of air by weight to one part of fuel vapor to obtain the proper results from the engine.

If over 15 parts of air is mixed with 1 part of fuel the mixture is too lean and various troubles will result. The motor will begin to miss and often will back-fire through the carburetor, which may set the latter on fire.

If less than 12 parts of air is mixed with 1 part of fuel the mixture is too rich. Very rich mixtures will not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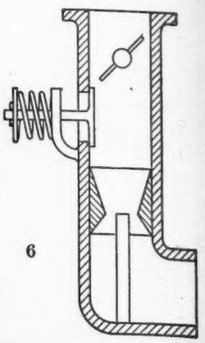
burn completely and a poisonous black smoke will be exhausted from the engine. The motor will soon carbonize badly and will very easily overheat. A rich mixture will cause the motor to lose its snap and it will not develop its full power. Therefore, in adjusting the carburetor, the mixture should be thinned down until the motor begins to miss and then increased just enough for the motor to run smoothly and pick up well.



This type of carburetor is losing prestige

Any ratio of fuel and air may be obtained at any given suction or engine speed by adjusting the size of the air and fuel openings. Naturally, as we use 12 to 15 parts of air to one of fuel, and as air occupies about 800 times as much space as the fuel, weight for weight, the fuel jet will be much smaller than the air passage.

In automobile practice the carburetor must give the correct mixture at all engine speeds. The speed and the power of the engine developed are regulated by the amount of the mixture that is taken into the cylinders. This amount is regulated by a throttle, as shown in sketch number 4. The mixture is sucked through the manifold *A* into the cylinders and the valve or throttle *B* regulates the amount of mixture that enters the engine.

The suction in the mixing chamber is regulated by the throttle. That is, when the throttle is opened the suction on the fuel jet is increased and also more air is drawn into the carburetor. If the amount of increase in air and fuel were in proportion a carburetor would be easy to design. But this is not the case, as the flow of fuel increases faster than the flow of air and the mixture tends to get too rich at high speeds and too lean at low speeds. There are a number of ways to correct this difficulty and therefore we have many designs of carburetors. However, there are only four fundamental designs and the various carburetors are one of these or a combination of them.

The design that would probably be the first to suggest itself would be a needle valve to vary the size of the fuel jet. A simple carburetor of this type is shown in sketch number 5. The needle valve which regulates the size of the fuel jet is regulated by an eccentric which is on the throttle shaft. This type is not very common, but it is used in several combinations with other designs.

Another type, which was very popular a few years ago, especially in America, but which is losing ground lately, is the auxiliary air valve type. A simple view of this type is shown in

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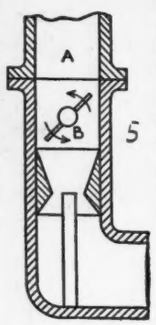
sketch number 6. An air valve is located above the venturi tube and below the throttle and is opened at high speeds to admit air to weaken mixture and to cut down the suction on the jet. There are two types of auxiliary air valves; one in which the valve is operated by a link motion from the throttle shaft and one which is held shut by a spring which will allow it to suck open at high speeds and admit enough air to correct the mixture. Both types are in common use and in one popular design they are used in combination with part of another type.

In a design which has won considerable fame on the speedway, and is gaining ground rather fast with the general public during the last few years, the size of both the air passage and the fuel jets are varied. The advantages claimed for this type are that it breaks up the fuel very well, gives a very homogeneous mixture, and very good mixture ratio at all speeds. One class of this type is known as the multiple jet carburetor. When running the motor slow one jet and one air passage are used. When it is speeded up another jet and air passage are added, and so on, until the correct amount of mixture is delivered. Some multiple jet carburetors have as many as 16 jets. The other class uses one jet which is controlled by a metering pin, and an air passage which is regulated in accordance with the fuel supply. There are many designs along this line, a few of which have been extensively used during the last few years.



A simple carburetor

The compound nozzle type is most used today and has been popular in Europe for some time. It is simple, easily manufactured, and almost foolproof. In this type it is common practice to use two jets of opposite characteristics. In one popular design the main jet supplies about ninety per cent of the fuel required to give a correct mixture at high speed, and ten per cent at low speeds. A compensator jet is used which supplies ten per cent of the fuel at high speeds and ninety per cent at low speeds. Thus a correct amount is supplied at any speed by the two jets. The layout of this device is shown in sketch number 7. The compensator nozzle is located around the main jet but it is in no way connected with it. The fuel is supplied to the compensator nozzle from a well which is open to atmospheric pressure. This well is fed from the bowl through a small jet which is located in the bottom of the well. The fuel flows into the well by gravity as the fuel level is higher in the bowl. As the engine speed is increased the suction is increased on both jets, but it does not affect the amount of fuel

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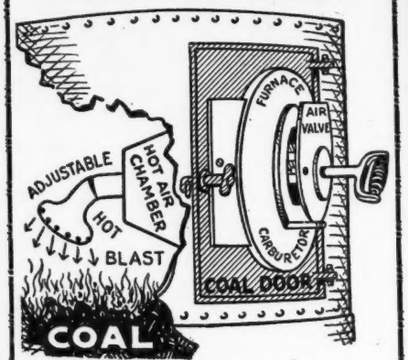

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A book devoid of technicalities. Simple, plain and understandable. $1.00 Postpaid.

Popular Science Monthly, 225 W. 39th St., New York

Ride a Bicycle

INSPECTION by the Chief. The Bicycle Corps is ready. Every boy spick and span. Every bicycle clean and shining, with tires sound and well inflated. Good scouts know that tires are mighty important. You couldn't afford to have a tire go flat on urgent duty.

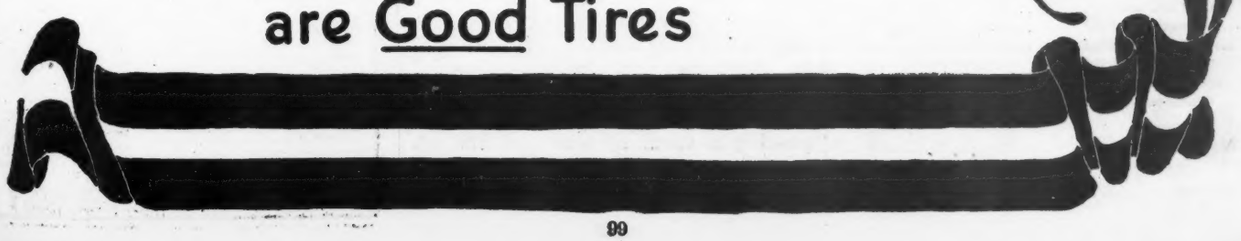
Line up the bicycles in any shipshape outfit and you will find a big majority of them are equipped with United States Tires.

That's because the boys with experience know that United States Tires are good tires. They are always reliable and give long mileage.

Boys who have looked into the matter know that these tires are made by the world's largest rubber manufacturer, the same company that makes the famous United States Tires for automobiles. They know the rubber comes from Sumatra where the United States Rubber Company has a plantation of 100,000 acres. They know this company has been making good tires since bicycles were first invented.

Remember these things when you get a new bike or when your old wheel needs new tires. Take a tip from experienced riders and be sure to get United States. There are numerous styles from which to choose both clincher and single tube.

United States Cycle Tires
are Good Tires



HIGH SCHOOL COURSE IN TWO YEARS

YOU ARE BADLY HANDICAPPED if you lack High School training. You cannot attain business or social prominence. You are barred from a successful business career, from the leading professions, from well-paid civil service jobs, from teaching and college entrance. In fact, employers of practically all worth-while positions demand High School training. You can't hope to succeed in the face of this handicap. But you can remove it. Let the American School help you.

FIT YOURSELF FOR A BIG FUTURE This Course, which has been prepared by some of America's leading professors, will broaden your mind, and make you keen, alert and capable. It is complete, simplified and up-to-date. It covers all subjects given in a resident school and *meets all requirements* of a High School training. From the first lesson to the last you are carefully examined and coached.

USE SPARE TIME ONLY

Most people *idle* away *fifty* hours a week. Probably you do. Use only one-fifth of your wasted hours for study and you can remove your present handicap within *two years*. You will enjoy the lessons and the knowledge you will gain will well repay the time spent in study.

YOU RUN NO RISK So that you may see for yourself how thorough and complete our training is, we invite you to take *ten lessons* in the High School Course—or any course of specialized training in the coupon below—before deciding whether you wish to continue. If you are not then satisfied, we will refund your money in full. *We absolutely guarantee satisfaction.* On that basis you owe it to yourself to make the test.

Check and mail the coupon NOW for full particulars and Free Bulletin.

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Explain how I can qualify for the position checked.

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...Hydroelectric Engineer	...Accountant and Auditor
...Telephone Engineer	...Bookkeeper
...Telegraph Engineer	...Stenographer
...Wireless Operator	...Fire Insurance Expert
...Architect	...Sanitary Engineer
...Building Contractor	...Master Plumber
...Civil Engineer	...Heating & Vent. Engineer
...Structural Engineer	...Automobile Engineer
...Mechanical Engineer	...Automobile Repairman
...Shop Superintendent	...Airplane Mechanic
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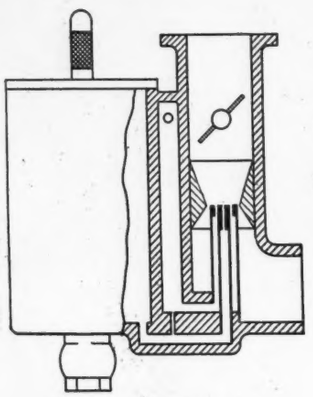
Name.....

Address.....

that is delivered from the compensator as no suction is exerted on the jet because the well is open at the top. If this jet was used alone it would tend to give too lean a mixture at high speeds.

Due to the abundance of fuel in America little attention has been paid to economy. Production has played a much larger part in the designs than it should have done, for often a change that saves fifty cents in the cost of the carburetor has wasted many dollars worth of fuel during the life of the car. It is evident that with the increased cost of fuel many changes will take place and probably we are starting on a new era of carburetion. Heating devices will receive much attention, as it is necessary to use lower grade fuels. It is hard to



The compensator jet, which regulates the fuel

predict which type of carburetor will win out, but the one that does must give the correct mixture at all speeds and loads.

Remedying Motor Drive Trouble

RECENTLY trouble was experienced with an eight-pole, 450 h.p., synchronous motor running at 60 cycles and 900 r.p.m., with a driving pinion having sixteen teeth. When the motor was started meters connected in the circuit showed that the load rose and fell in regular periods, increasing in value with each period until the circuit breaker would trip out. Under these conditions operation of the machine was impossible.

An examination brought out the fact that it was a case of harmonic load building brought about by the fact that a 16-toothed pinion had been selected to run on a shaft driven by an eight-pole motor. The frequency of the motor and the impulses to the machine driven by it being too nearly alike caused a resonance in the system, and this, being intensified by irregularities in the gear teeth, caused the load to fluctuate and increase beyond control.

The trouble was finally remedied by putting a small fly-wheel on the set to take up the periodic load fluctuations.—PETER J. M. CLUTE.

He Made $800 First Two Months

You can start in the same business for little money.

C. T. Patterson of Illinois opened 3 American Box Ball alleys and cleaned up $800.70 in the first two months. Now he operates eight alleys and out of the proceeds has built a beautiful three-story home. Scores of proprietors of American Box Ball Alleys are earning $100 a week or more from just two alleys. *You* too, can make big money out of this fascinating game. We make it easy for you to start.

American Box Ball

A 5c game that appeals to everyone, women as well as men. More fun than ordinary bowling. Practically 100% profit. No operating expenses—no helpers, no wages to pay. Pins are reset and balls returned automatically. New automatic electric lighted score board makes a big hit. Be the first in your locality with Box Ball Alleys. Very little cash needed. Pay as the Alleys earn.

Write Box Ball has come to stay! See for yourself the money that others are making. Write us for the amazing facts and full description of the equipment and particulars of our easy payment plan. Write today. A post card will do. No obligation.

American Box Ball Co.
809 Van Buren St., Indianapolis, Ind.

3 Cash Prizes!
$100.00 $50.00 $25.00
10 CONSOLATION PRIZES
STERLING SILVER CIGAR LIGHTER

INVENTORS EXPERIMENTERS

Use your ingenuity and win one of these cash prizes by showing some new uses for

LIBERTY BRAND FERRO-CERIUM Or SPARKING METAL

Ferro-Cerium is the metal used in cigar lighters to produce the spark showers. It has been developed to such an extent that the results obtained are marvelous.

We are anxious to discover new uses, such as sparking toys, safe and sane fire works, technical uses, etc. Any ideas used will be paid for.

Write at once for details, sample of Ferro-Cerium, and rules of contest

NEW PROCESS METALS CO.
50 E. 41st St., New York

$100.00 A WEEK

We want at least one well-acquainted ambitious driver in every locality to demonstrate and sell a wonderful new puncture-proof tire. Givens Beadless Tires cost only half as much, yet guaranteed

5000 Miles Puncture-Proof

They're also oversize, better looking and easier riding. We help you establish a substantial flourishing business of your own, the weekly profits from which will amaze you. We show you how and give you every help. If you are ambitious to build a big business of your own, and are now making less than $100 a week, write or wire at once.

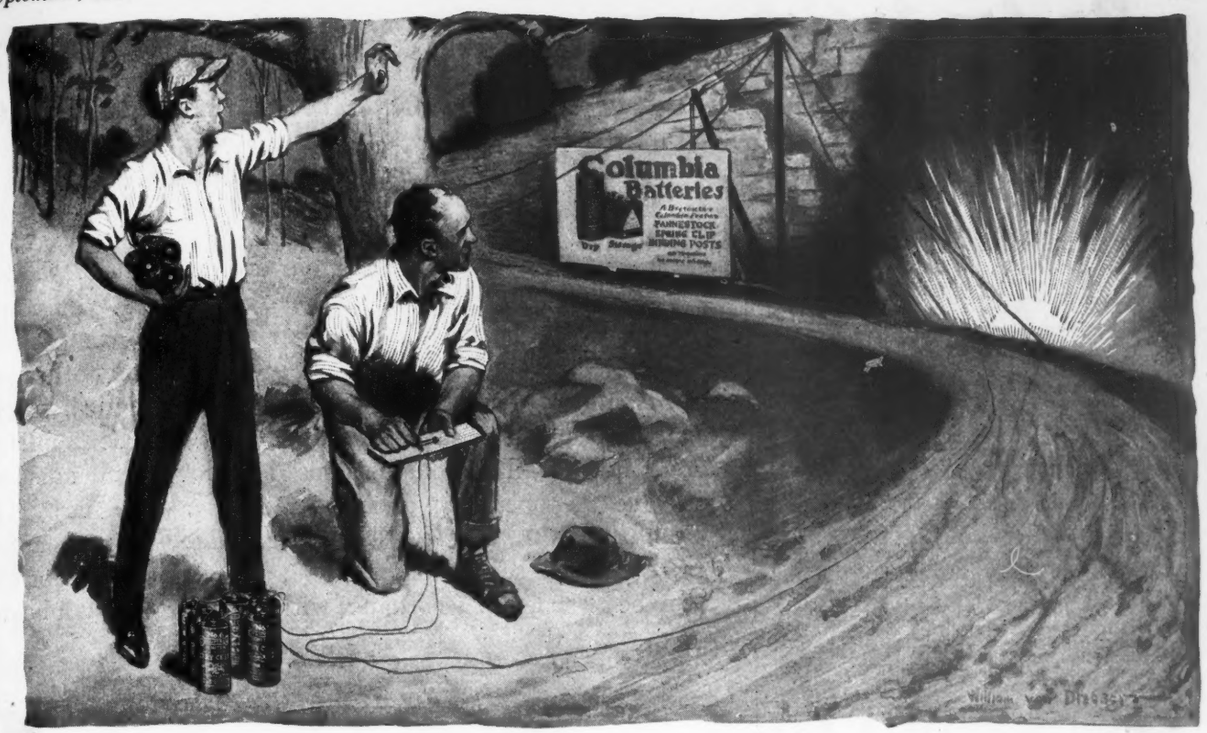
GIVENS CONSOLIDATED RUBBER CO.
216 Second St. San Francisco

Indoor Toilet

Convenient — Sanitary

The Comfort Closet for Homes, Summer Cottages and Camps. Entirely odorless. Scientifically ventilated. Strong chemicals dissolve contents; kills all germs. Easily installed. Convenient to move. Contents disposed of easily as garbage. Prevents fly breeding and water contamination. Provides sanitary, odorless toilet in home protected from cold and stormy weather. Only closet with porcelain container. Easily cleaned. Approved by U.S. Health Bureau. 30 Days' Free Trial. Agents make $60 to $100 weekly. Exclusive territory. Ask for booklet—FREE.

Comfort Chemical Closet Co., 1329 Factories Bldg., Toledo, O.



"Bingo! . . .The Fiery Little Columbia is Always There With the Ignition Punch!"

QUARRY BLAST CHARGE and auto engine gas are alike to the Fiery Little Columbia. The power's in the fuel; but it takes the Columbia hot spark to set it to work.

That's a regular Columbia job—releasing energy by ignition.

THE DRY BATTERY

WHAT a marvelous little bundle of big ability the Columbia Dry Battery is! And what a multitude of uses! It makes bells jingle and buzzers buzz; whirls the youngsters' toys into a riot of fun; gives snap to telephone talk; puts a swift and powerful kick into the ignition of autos, trucks, tractors, farm engines, and motorboats.

THE STORAGE BATTERY

IN the storage battery field the name Columbia means *definite power guaranteed for a definite time.* Columbia Service Dealers and Service Stations are everywhere—they make that guarantee good.

Step in and let them tell you how the Columbia Storage Batteries are distributed, and how the Columbia Service Plan insures that the motorist shall have the full service to which his original purchase entitles him.

Columbia Dry and Storage Batteries

H-19

Be An Artist

Release the Talent in Your Pencil

Everybody has the ability to draw. True, some have more ability than others—but that is because it has been developed. Just as you have been taught to read and write, you can be taught to draw. It's simply a question of the *proper* training. Why stick at a routine job, wasting your life away, when there is a crying demand for trained illustrators—cartoonists—and designers? Our wondetrful NEW METHOD of teaching art by mail has qualified hundreds of our students for high-salaried positions. Under our instruction, your undeveloped ability will flow forth in streams of saleable pictures, and you will have

A Career— Not a Job

A career is open to you as commercial artist that has *definite* possibilities. There is no future for you in a "job." There are thousands of big paying Artist's positions open *right now*. And these positions are actually *going begging* because of the scarcity of trained artists. Magazines, newspapers, advertising agencies, business concerns—all are looking for men and women who can handle their illustrating. With the tremendous boom in both foreign and domestic business, commercial art is more in demand than ever,—and that demand is growing every day! Get in this fascinating game NOW!

$100 for One Drawing

That is what many of our students are now getting for one drawing! Many, after completing this wonderful course, have even started in at $60a week! Often, even before the student has finished his course, he has made more than enough through the sale of his drawings to pay for his tuition. Why? Because he learned to draw under the *personal* instruction of one of the country's foremost commercial artists — Will H. Chandlee. The Chandlee system does away with all superfluous technique and entangling hindrances of the ordinary art school. It brings the principles of successful drawing right down to fundamentals in a course of instruction that can't be beat. You can get all the benefits of studio instruction right in your own home,—and for just a few cents a day! Your spare time is all that is required. Our valuable book "How to Become an Artist" tells all about it. Send for it today! It's FREE!

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Please send me, without cost or obligation on my part, your free book "How to Become an Artist."

Name.....

Address.....

What Can You Do with the Exhaust of a Gasoline Engine?

The Popular Science Monthly will pay fifty dollars for the best answer

WHAT can you do with your engine exhaust? Is it an automobile, boat, or stationary engine? We know of one man who heated his greenhouse with the exhaust from his stationary engine. There are, of course, many other uses for it, and we want to know in how many practical ways it can be applied to save time and money. The appliance must not retard the engine's speed or power and must not involve the operating of another engine. Tell us! THE POPULAR SCIENCE MONTHLY offers three prizes,—a first prize of $50, a second prize of $25, and a third prize of $15, —to be awarded in accordance with the rules set forth below:

Rules Governing the Contest

(1) Contestants are not limited to the number of methods of utilizing the exhaust which they may describe, but only one method can possibly win the first prize, only one the second, and only one the third. The contest is open to everybody.

(2) The method must be clearly shown either in a photograph or in a drawing. If a drawing is sent in, it need not be made by a skilled draftsman. It is sufficient that it should be intelligible. While pencil sketches will be considered, contestants are requested to make their drawings in ink on bristol-board. The views should be sufficient in number to set forth the use of the engine's exhaust very clearly. The contestant's name and address should appear on each sheet of drawings.

(3) The drawings or photographs must be accompanied by a description, preferably typewritten, in which the method is clearly given. It must be written on one side of the paper only, and it should not be more than 500 words in length. The name and address of the contestant should appear in the upper left-hand corner of the first sheet of the written description.

(4) The drawings and description entered by contestants must be received by the POPULAR SCIENCE MONTHLY not later than 5 P. M. on Friday, October 31, 1919.

(5) The judges of the contest will be the editors of the POPULAR SCIENCE MONTHLY.

(6) The first prize of $50 will be awarded to the contestant who, in the opinion of the judges, has suggested the simplest and best method of utilizing the exhaust of a gasoline engine.

The second prize of $25 will be paid to the contestant who submits a method next in merit.

The third prize of $15 will be paid to the contestant who submits the method third in merit.

(7) The winners of the contest will be announced in the earliest possible issue of the POPULAR SCIENCE MONTHLY. A description of the methods which win the three prizes offered will duly appear in the pages of the POPULAR SCIENCE MONTHLY, together with the names of the winners.

(8) The editors of the POPULAR SCIENCE MONTHLY shall have the right to publish meritorious manuscripts which do not win a prize. The regular space rates will be paid to the contestants who submit the manuscripts thus selected.

(9) When a contestant submits more than one method, the description and drawing by which each is set forth must be sent as a separate unit.

(10) Manuscripts or drawings will be returned to contestants if stamps are enclosed.

(11) Send drawings and specifications to the Engine Contest Editor, POPULAR SCIENCE MONTHLY, 225 West 39th Street, New York City.

Camel

Camels supply cigarette contentment beyond anything you ever experienced!

YOU never tasted such full-bodied mellow-mildness; such refreshing appetizing flavor and coolness. The more Camels you smoke the greater becomes your delight—*Camels are such a cigarette revelation!*

18 cents a package

Camels are sold everywhere in scientifically sealed packages of 20 cigarettes or ten packages (200 cigarettes) in a glassine-paper-covered carton. We strongly recommend this carton for the home or office supply or when you travel.

R. J. Reynolds Tobacco Company
Winston-Salem, N. C.

Everything about Camels you find so fascinating is due to their quality—to the expert blend of choice Turkish and choice Domestic tobaccos. You will prefer this blend to either kind smoked straight.

You'll say Camels are in a class by themselves; they seem *made to meet your own personal taste* in so many ways!

Freedom from any unpleasant cigaretty aftertaste or unpleasant cigaretty odor makes Camels particularly desirable to the most fastidious smokers. And, you smoke Camels as liberally as meets your own wishes, for they never tire your taste! You are always keen for the cigarette satisfaction that makes Camels so attractive.

Your personal test of Camels will bring you a lot of real cigarette happiness. Smoke them today—then take this advice: *Compare Camels with any cigarette in the world at any price!*

Cigarettes

Save TIRES LIKE THESE

I Earned $2200 In Four Months

This is Richard A. Oldham

Mr. Oldham was te. graph operator for the Illinois Central Railroad for twenty years He is fifty-eight years old. One day he read one of my advertisements and the possibilities of making money in Auto Tire Surgery business. In a few weeks he had purchased and installed a Haywood outfit. A short time afterward he wrote us that his income in four months was as much as it had been in Two and One-Half years as Telegraph Operator.

Be a TIRE SURGEON

Make $2,500 to $4,000 Per Year Giving New Life to Old Tires

A Haywood Tire Surgeon can do more with old tires than was even dreamed before the war. By the **Haywood Method a Haywood Tire Surgeon** can give 4,000 to 5,000 more miles of new life to a tire that two years ago would have been thrown on the junk pile. And it's easy to learn.

HAYWOOD'S TIRE SURGERY

Stations are Needed Everywhere

20,000,000 tires wearing down every day. By Tire Surgery you can quickly repair, rebuild and give new life to tires seemingly all worn out. Cuts, gashes, tears, bruises, broken fabric, every kind of an accident that can happen to **any** tire, inside or out, you can repair and save for long service. **The chance to make money is simply wonderful.**

$2,500 to $4,000 a Year is Possible

If we told you all the truth you wouldn't believe it. You would say, "it is too good to be true." But you can see what a great field there is for **Haywood Tire Surgery Stations**—for this better way.

WITH THIS HAYWOOD OUTFIT

WRITE TODAY

Send Today for My Free Book

I have ready to mail you the day I get your request, a fascinating book—all about tires—how to repair them by the Haywood Method—how to start in business—how to build up trade—what to charge. In 48 to 72 hours you can have the whole proposition right in front of you. Use coupon at the left.

M. HAYWOOD, President
HAYWOOD TIRE & EQUIPMENT CO.
1116 Capitol Ave. Indianapolis, Ind.

DEAR SIR: Please send me by return mail your free book on the new Haywood Tire Surgery Method and the details of your free school of tire repairing.

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Haywood Tire & Equipment Co.
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Indiana

Complete Musical Outfits On Trial

YOU may have your choice of instruments and a complete musical outfit for a week's free trial in your own home. Outfit includes case, music rack, all accessories, instruction book, etc. at factory prices. A tremendous saving.

Convenient Monthly Payments

After trial return outfit at our expense if you wish. If you decide to buy you may pay the low direct price in small monthly amounts. Wurlitzer for 60 years has meant highest quality.

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Send free your 160-page catalog with full details of complete musical outfit on easy terms.

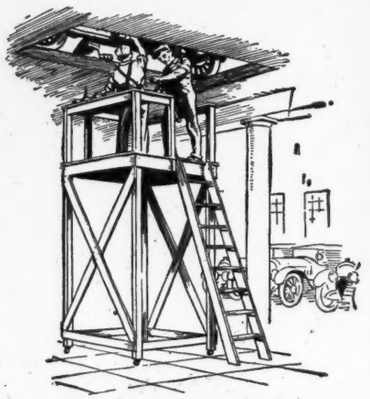
Name .....

Address .....

Instrument I am Specially Interested In.....

A Scaffold Replaces the Old Repair Pit

THE repair pit is, at best, a most uncomfortable place to work in, and to do away with it a large public garage has resorted to the method shown in the illustration. A trap was cut in the floor above the repair shop



The car being repaired is on the floor above

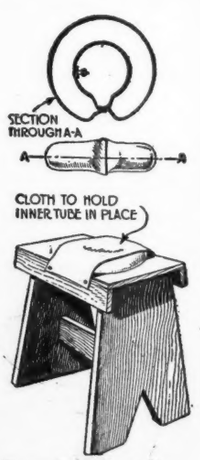
and the car to be repaired was driven over the hole in the floor. A scaffold, having a platform about 4 ft. square, was then wheeled into place, underneath the hole. On the platform is a small bench with a vise, and drawers for nuts, bolts, etc.

The result has been a saving in time, for the workman has a place in which to work, plenty of room to move about, and he can work steadily without having to climb down for tools.—W. R. DAVIS.

Making a Pneumatic Seat for Shop Use

SITTING eight or ten hours on an ordinary backless shop seat invites fatigue almost as great as if the worker had been standing instead of sitting. One way to relieve this fatigue is shown in the illustration.

A piece about 20 in. long, is cut from an old automobile tube. It should include the valve. The ends of the section are stuck together with rubber cement and allowed to dry thoroughly, after which they are tested for leaks. If it is found airtight the tube is bent into a rough circle and the flaps cemented to each other, forming what has been called a "life preserver" from its resemblance to that apparatus. When inflated to fifteen or twenty pounds pressure, this ring makes a comfortable cushion.—D. A. HAMPSON.



It makes life easier for the workman

Utilizing a Second-Hand Magneto

IT is sometimes necessary to adapt to one type of gas engine a high-tension magneto intended for another type. This is apt to be a rather puzzling job, especially in the case of motor-boats, in which a great variety of engines are in use.

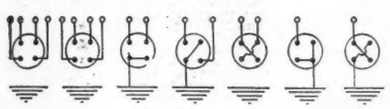
The following table shows at a glance the proper gear ratio and distributor connections for all cases that can be handled without alteration of the magneto itself. The gear ratio referred to is that of the crankshaft to the main shaft of the magneto. For example: if the ratio given is 2, then the magneto armature must make two revolutions for each revolution of the engine. The leads, shown in the diagram as rising from the distributor, go to the cylinders in their proper firing order. All others must be grounded, to protect the magneto from excessive voltage.

1. FOUR-CYLINDER MAGNETO

{4 distributor terminals / 2 sparks per revolution}

No. of cylinders	4	4	2*	2†	2	1	1
2 or 4 cycle	4	2	4	4	2	4	2
Ratio {revolutions of magneto for each revolution of crankshaft}	1	2	1	1	1	1	1

Distributor connections:



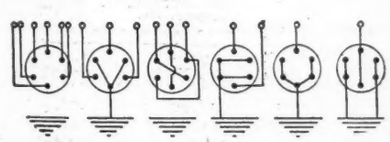
*For engines with crankshaft opposite; usual 2-cylinder, 4-cycle type.
†For engines with cranks together (0°); also double opposed engines with cranks opposite.

2. SIX-CYLINDER MAGNETO

(6 terminals, 2 sparks per revolution)

No. of cylinders	6	3	3	2	1	1
2 or 4 cycle	4	4	2	2	4	2
Ratio	1.5	1.5	1.5	1.5	1.5	1.5

Distributor connections:



Of course the system works both ways. It is often possible to adapt a magneto to an engine having more cylinders than the one for which it was intended by purchasing comparatively inexpensive parts—a new distributor cover, and, if the magneto gives but one spark per revolution, new breaker cams. However, it is almost out of the question to shift over from the six cylinder class to the four, and vice versa.

If the engine is too heavy to start on the magneto, as often happens in motor boat work, the addition of a simple vibrator and resistance, connected, as shown in the first sketch, makes it possible to start on batteries.

"This Feed Saves Drill Points"

It doesn't take long for the "YANKEE" Bench Drill to earn itself by saving the breakage of drill points. The Automatic Friction and Ratchet Feed, indicated in the illustration, regulates the feed as nobody could ever do by hand.

In operation, the drill is run down to contact with the work by the Friction Feed. The moment the drill begins to cut, the feed *automatically* changes to Ratchet movement, giving an absolute uniform pressure through the cut. Even drill points as small as No. 45 are not broken in use, regardless of the inexperience of the operator, because it is impossible to over-feed

"YANKEE" Bench Drill

No. 1005. Two speeds, 3-jaw chuck, holds drills up to ½ in. Height, 28 in. Price, (Philadelphia) $21.00

No. 1003. 2-jaw chuck, holes drills up to ¼ in. Height, 18¾ in. Price, (Philadelphia) $12.50

"YANKEE" VISE, No. 990

Accurately machined sides, ends and bottoms, for holding work on Bench Drills and other machine tools. Swivel-jaw for taper work; groove for holding rounds. Base, 6 in. long; 2⅝ in. wide. Price $3.10

Your Dealer Can Supply You.

Write for free "YANKEE" Tool Book showing "YANKEE" Tools in action; illustrating Bench, Breast, Chain and Hand Drills, Ratchet Tap Wrenches, Removeable Vises, Ratchet, Spiral Ratchet and Plain Screwdrivers, all having unusual features of advantage over other tools.

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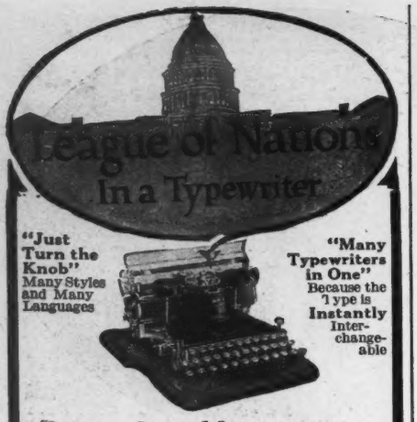

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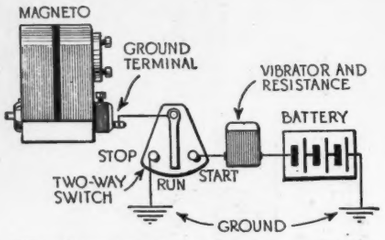
These vibrators are sold by several magneto firms. In an emergency they can be improvised. Last year I used the vibrator of a broken-down spark coil in this way for more than a month, and, as an experiment, an electric bell vibrator for a short time. Of course they were rather unsatis-



When heavy engines are to be started the contrivance depicted above simplifies it

factory, particularly the latter; but without them we could hardly start up at all. If you improvise such a system, be very careful to have enough resistance in the circuit to protect the magneto from the full short circuit current of the battery.

The best arrangement of all for starting a heavy engine is probably the impulse starter so commonly used upon tractors. With such an outfit you are independent of battery worry and expense. Such starters can be had at moderate cost, or even home-made, if one has the necessary facilities.—JOHN A. PRIOR.

Make a Weeder from an Old Wagon Spring

NOW is the time to weed out those unsightly spots on your lawn and get it in condition for fine velvety grass to grow up next year.

The usual tool for cutting weeds is an old case knife, but the tip of a broken wagon or automobile spring is far better, as it will stand more prying when removing the weed's root. The

Grind down the tip of an old wagon spring into a lawn weeder

length of the blade from the handle to the cutting edge is 6 in., the spur running out about 1½ to 1¾ in. more.

The cutting edge should not be squared across, but slant inward at about the angle shown, so that in press-

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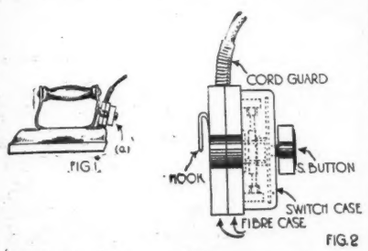
ing it forward, the roots may be drawn toward the spur, rather than outward. The cutting edge should be sharpened from both sides, like a knife, rather than from one side like a chisel. Wooden side-pieces riveted to the shank form the handle, but if the knife is made from heavier material it would be better to draw the material down to a square or round shank, and insert the handle with ferrule.

This improvised lawn weeder can also be used in the garden, for it is invaluable for loosening the soil about growing vegetables and for transplanting delicate shoots, etc. Oil will keep it from rusting.—C. A. PEASE.

Repairing the Wires on an Electric Iron

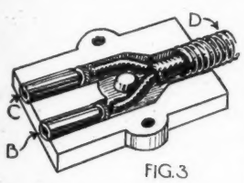
A FEW days ago the switch on our electric iron was broken. It was taken to an electrical shop, but the dealer wanted $2.50 for a new switch,



The iron as it originally appeared, and details of the old switch

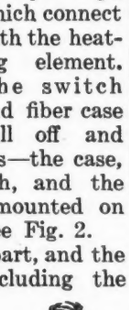
which was almost what the iron was worth. The old switch was taken home and the connection repaired in the following manner, at the mere cost of a few minutes' labor.

In Fig. 1 is shown the switch and iron complete. The switch is held on the handle of the iron by a hook and also slips down on two prongs which connect with the heating element. The switch and fiber case pull off and are composed of two parts—the case, which protects the switch, and the switch proper, which is mounted on the back of the case. See Fig. 2.



The wires connected to the terminals

The casing was taken apart, and the whole of the switch, including the binding-posts, was removed, with the exception of the two metal terminals *B* and *C* and the protecting spring *D* on the inside.



The complete connection

The cord was then connected direct to *B* and *C* as shown in Fig. 3, and the other half of the casing was put in place and fastened. See Fig. 4.

The casing was slipped back on the iron and the current turned on and off at the lighting fixture instead of the iron.—ALBERT E. JONES.

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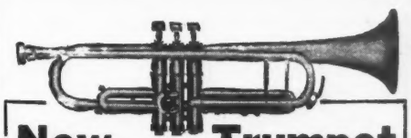

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So we all took our Auto-Wheels down to the show-lot, and when the march started we joined in. We hitched on to the biggest elephant in the show and followed along.

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The New Fad—Metal Flowers

By David Baxter

METAL roses—in fact, any flowers made of metal—require considerable skill and patience in making, but the work is not so difficult if one understands the "trick" in the method. In fact, any fairly ingenious mechanic can make metal roses with but a few tools once he grasps the idea.

The flowers may be made to look as natural and beautiful as nature's product, and they never fade or wither.

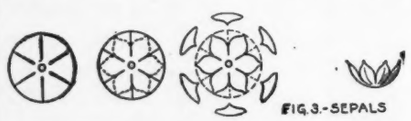
You will need a quantity of round iron rods 3/16 in. in diameter, a sheet

The rod is now hammered into the form of stems and rose leaves

of 1/32 in. black wrought sheet-iron, a hammer, a chisel, a pair of snips, tongs, and an anvil, a blacksmith's forge, or, better, a welding-torch

The Leaf

Cut off a piece of the iron rod, five inches long or thereabouts; heat one



The sepals are marked out in a chalked circle, cut and hammered thin, then bent into shape

end of it bright red and hammer it to a long point like that of a pencil; heat the other end and make it slightly wedge shape. Now reheat the pointed end and flatten it; hammer it out until it is wide and thin, when it should have the general shape of a rose-leaf. Heat again to a dull red, and mark the veins with the chisel; also cut the little notches around the edges. Then bend it to the shape of a rose-leaf. See Fig. 1. Make several leaves and weld them together.

The Stem and Sepals

The stem is made next, from a piece of the iron rod about the dimensions of the leaf piece. Wedge one end of this and draw out the other end to a smaller diameter, as shown in Fig. 2.

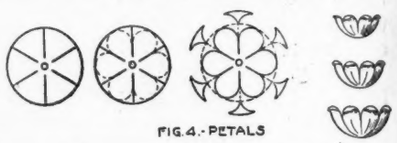
Cut out a circular disk of the sheet-metal with the snips, and mark off six sections with chalk. Make the disk about two and a half inches in diameter. Now drill a hole through the exact center large enough to fit the small end of the stem. Mark it off into sepals and trim them out. Now heat the sepals one at a time and hammer them thin with the ball peen of the hammer and bend them into shape.

Petals

To make the petals, cut three disks three inches in diameter from the sheet-iron. Punch a hole in the center of the petal sections the same as in the sepal sections. Cut on the dotted line and trim the petals. Heat each petal in turn to a bright red and hammer very thin. Keep hot while hammering to prevent cracks. Use snips to trim the ragged edges and to round out the petals. After the petal sections are hammered and trimmed, heat each one and mold it into a cup shape with the ball peen of the hammer. Cup all the sections so that they will fit one within the other. (Fig. 4 illustrates all this procedure.)

Articulating the Parts

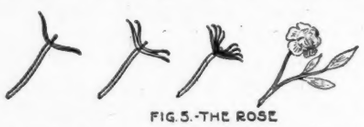
Now to put the rose together. Slip the sepal section onto the shank of the stem piece. Solder it in place; or, better still, weld it in place. Bend the edges up to the proper shape to fit the bottom petal section, which is added next. Squeeze the first petal section within the sepal section, and fasten with a drop of solder. Then squeeze in another petal section, and solder it. Draw each section inward more or less, according to whether it is desired to make a full-blown rose or a bud. Have one edge of each petal fit on the inside of the others in rotation around the rose. Follow the second petal section with the third and last one, lapping the petals in the same manner as on the others. Melt a quantity of solder over the end of the stem to hold the petal sections firmly



The petals must be kept at red heat when they are being pounded and molded into shape

in place. (Fig. 5 shows this part of the work.) The metal, being thin and pliant, can be readily shaped with a pair of pliers.

If an acetylene welding plant is at hand the welding may be substituted



The whole process is interesting and the resulting effect is really artistic

for the soldering, and it makes a better job. The welded rose must be put together hot .

The last step is to weld or solder the leaves to the stem. This should be done with particular care, as all of the work will be in sight.

The foregoing idea may be enlarged and varied; for instance, a number of roses may be welded to a ring of iron to form a wreath. The metal roses are pleasing enough in metal colors, but may be enameled in different colors, especially if a wreath is made. Copper may be employed instead of sheet-iron.

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You can do it, if you will stop—think—appreciate the toboggan you are on, and take steps at once to remedy the conditions that are making a sickly failure of your life.

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..Asthma	..Flat Feet	..Heartweakness
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..Lumbago	..Torpid Liver	..Lung Troubles
..Neuritis	..Indigestion	..Increased Height
..Neuralgia	..Nervousness	..Stoop
..Flat Chest	..Poor Memory	Shoulders
..Deformity (describe)	..Rheumatism	..Muscular Development
	..Bad Habits	

NAME.....

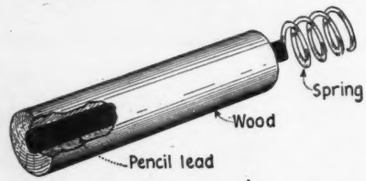
AGE.....OCCUPATION.....

STREET.....

CITY.....STATE.....

An Emergency Magneto Brush

I FOUND myself stranded on one occasion with complete ignition failure, and investigation revealed the fact that the high-tension brush of my magneto was fractured. The nearest town being about five miles distant, I decided that before starting to push



A temporary motorcycle magneto repair was accomplished with a piece of lead pencil

the motorcycle in I would do my best to make some sort of repair and risk riding the machine with the fragment of the old brush still in the magneto.

The absence of a file from my tool kit made it impossible to shape any piece of steel or brass satisfactorily, even if I had been willing to risk scoring up the slip-ring. It suddenly occurred to me that the "lead" in a pencil is only another form of carbon, and as such is, of course, a conductor. Further, the wood surrounding it would do no harm to the slip-ring. I had very little difficulty in whittling a piece of pencil until it was a fairly good fit in the carbon brush-holder.

Of this, I cut off a length equal to that of the old brush, and stripped all the covering off the lead for about ⅛ in. at one extremity. I then altered one end of the spring so that a few turns were wrapped round the projection thus produced. The other end of this improvised brush was smoothed off by rubbing it on the sandpaper on a match-box, and the job was done.

My only doubt was as to whether the small rod of carbon, being imbedded in the wood and flush with it at the end, would not make sufficiently good contact to collect the current. This would have been the case, probably, had I been dealing with low-voltage current.

On fitting the emergency brush I was delighted to discover that the engine ran quite as well as usual, and I firmly believe that I need never have replaced this extemporized brush with a new one.—G. F. COLLINS.

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THIS machine is suitable for the professional because it makes for greater production in less time, and with least exertion; it is a good thing for the amateur on account of its simple and inexpensive construction, and because of the ease with which a good print may be obtained.

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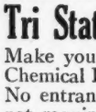

Either pin illustrated made with any 3 letters and 2 figures, Enameled Red-White-Blue, Silver plate 20c ea., $2.00 doz. Sterling silver, 35c ea., $3.50 doz.

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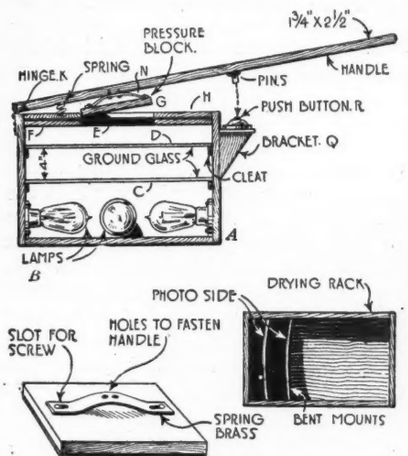
The box is shown at *A*, in the bottom of which are fastened the lamps *B*. These are covered with a ground glass *C* and another ground glass, shown at *D*, should be placed about 4 in. above *C*. This will greatly help to diffuse the light. At *E* a piece of plain glass (window glass will do) is shown, which is held in place by the frame *F*. In this an opening is cut a little larger than the largest plate or film you expect to print from. The top frame *H* can be made the same size as frame *F*. An arm *I* is hinged at *K*. At *L* a spring is put between arm *I* and frame *H*. The pressure block is secured to arm *I* in such a position that it will enter the opening in the upper frame when the arm is lowered. The method of fastening the pressure board to the arm is more clearly shown in the lower part of the illustration. A flat spring *N* is secured to the arm, and to this, in turn, is fastened the board by means of wood screws going through the slots *P* in spring *N*. These slots must be provided in order to allow the stretching of the spring when it is compressed. At *Q* is shown a block, on the top of which an ordinary push-button *R* is fastened. This is connected with the lamps, so that when the button is pressed down all the lamps will light up. A pin *S*



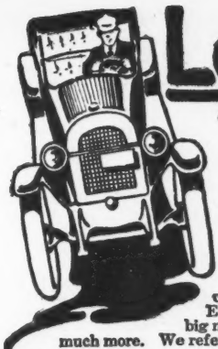
Eliminating chance from printing photographs, this machine makes excellent prints

is provided on arm *I*, just opposite the push button, and it must be long enough so that when the arm is in its lowest position the button is pushed in to close the circuit.

The printing is now done in the following manner:

Place your plate or film on top of the plain glass *E* inside of the opening *G*, put the paper on top of the negative and press down arm *I*, holding it in position the required length of time to expose the print correctly, let go of the arm and the spring *L* will act. That is, the arm will swing up high enough to allow you to insert a new sheet, after removing the printed one.

The wiring should allow one lamp to remain lighted for use as a safe light behind a panel of orange glass in one side of the box.—J. LIMBRUNNER.



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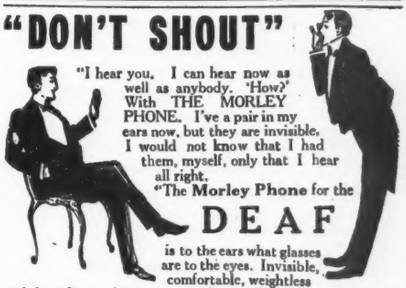

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For the Radio Experimenter

How Radio Aided the R-34

By Lloyd E. Darling

BELOW the POPULAR SCIENCE MONTHLY *presents the only pictures of the dirigible R-34's radio equipment ever taken, either in this country or in England. From a historical standpoint the apparatus is as important as any signalling equipment Columbus may have had on his momentous voyage to these shores—the crude flags, or whatever they did a little communicating with in those early days. Certainly, from the standpoint of momentous consequences, the two voyages themselves are on a par.*

Representatives of the POPULAR SCIENCE MONTHLY *received special permission from Major G. H. Scott, commander of the airship, to go on board the control gondola,—the ship's nerve center,—and make pictures. They were the only press representatives accorded such privileges while the airship was in this country, and but few others obtained so intimate a view of this highly technical part of the ship. Besides the radio pictures that follow, the one of the forward part of the control cabin on page 81 of this issue was also obtained at this time.*

Lieutenant R. F. Durrant, the ship's radio officer, was most kind in giving as extensive information as possible of the radio equipment in the limited time available. Since the radio cabin of the R-34 has a floor area only about as large as two flat-topped desks, the photographer had to exercise considerable skill in getting good pictures. A photographer had tried it in England, but without result. To radio enthusiasts and technical men of this country who wonder what wireless equipment such a great ship as the R-34 had, this story will be of high interest.—EDITOR.

"THE ship has three radio-sending sets, or really four if you count in the radio telephone unit which is auxiliary to one of the others," said Lieutenant R. F. Durrant, Radio Officer of the dirigible airship R-34.

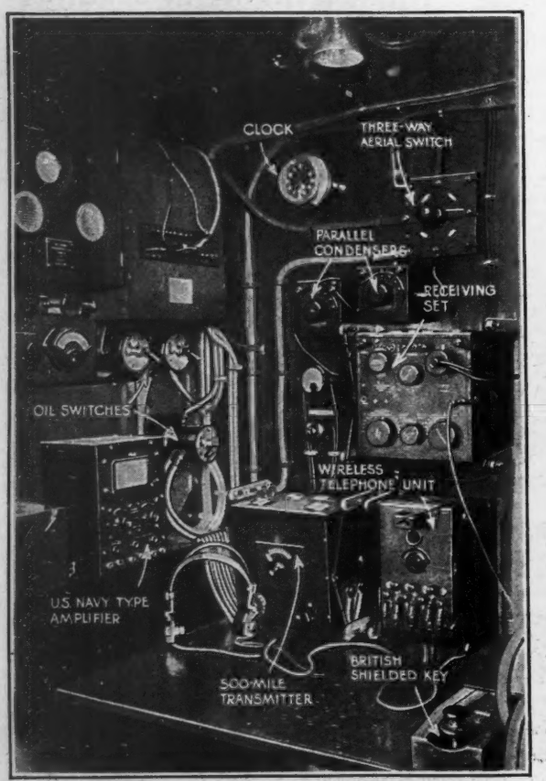
"The first of these sets is a high-power transmitter. It operates on the continuous wave principle, two British Thompson-Houston 250-watt vacuum valves supplying the power. One alone of these valves may be used, or two may be operated in parallel. The valve's filaments take 3.6 amperes each. High-tension potential applied varies from 1,000 to 3,000 volts. This comes from a small Newton generator set, driven by a three-and-a-half horsepower motorcycle engine. The 1,000 to 3,000 variation in this set's output voltage is secured by varying its field current with a suitable rheostat. With this outfit I can work 1,200 miles without trouble, and upon one or two occasions have reached as much as 1,500 miles. I am a firm believer in the future of continuous wave transmission. It will be much used."

It had been difficult enough to get up into the R-34 during its stay in the United States.

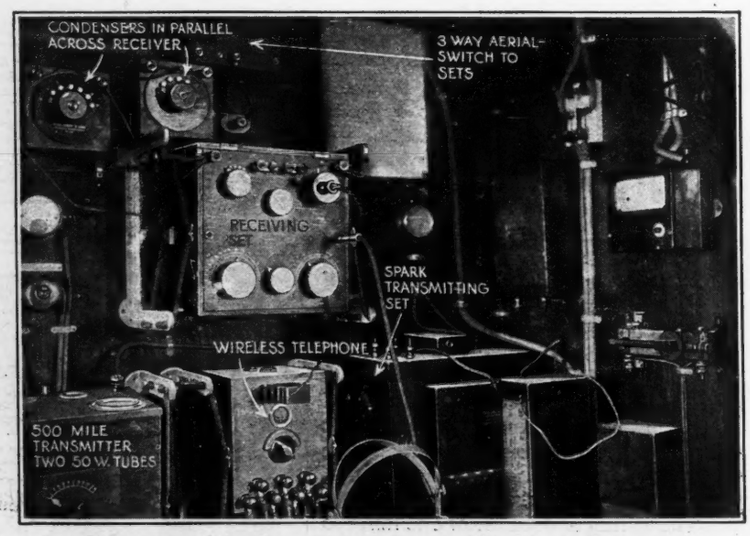
There were barriers enough to pass. For instance, the three rows of guards, arranged in concentric rings around the airship, with about a city block between rings. With some of these guards, even a pass from the commander of the ship was "no good." Their breechless shot-guns were not nearly so fearsome as they looked, however, and a word to the commander of the guard by the English officer who took you in charge soon opened a way.

Once inside the control car you had a feeling of being within a greenhouse or a limousine, you couldn't be exactly certain which—the windows around the side were so plentiful and the equipment in general so neatly polished and comfortable.

The control car of the R-34 is of the same general proportions as a small-sized street car, minus its wheels. But the roof is lower and the body has the streamline shape common to present-day aircraft. To get up into the car you grasp the handrail at the bottom just as the men in the picture on page 114 are grasping it, seizing as you go up such projections as you can get hold of, monkey-fashion. When airships are used generally for transatlantic travel, the builders will have to devise different passenger-loading methods, particularly for portly ladies.



Left corner and rear wall of the R-34's radio cabin. Note the smallness of the room and the compact arrangement of the radio apparatus


CONDENSERS IN PARALLEL ACROSS RECEIVER
3 WAY AERIAL-SWITCH TO SETS
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500 MILE TRANSMITTER TWO 50 W. TUBES

The radio cabin's right corner and rear. This view and the one at left overlap. Between the two you see most of three sides of the room. All the Atlantic talked here during the flight

Forward in the control car are the wheels and levers that control the ship's rudder and the elevators (not passenger elevators, but the side fins on the ship's body near the tail that regulate up-and-down motion in the air). The rudder and elevator control apparatus has the general appearance of similar machinery in an ocean-going vessel's pilot-house. Here also, in the forward end of the car, are shelves and a little table for navigating apparatus and maps. Meters and dials cover the walls.

The control car is divided into two equal parts by a crosswise partition at the center. To the rear is an engine-room—one of four engine-rooms on the airship, the others being in special gondolas farther along the great gas-bag's length.

Immediately in front of the forward gondola's center partition is the radio operator's cabin. This is a little room about six feet long by four or five wide, with a narrow passageway on the outside, which resembles the corridor in a compartment railway car. Of course the scale is much smaller but the workmanship on the woodwork and its neat finish remind one of a Pullman. Inside the radio cabin was Lieutenant R. F. Durrant, the ship's radio officer. His explanations of the equipment under his charge were most satisfying. He continued:

"The second set is a specially constructed continuous wave transmitter using two British Thompson-Houston tubes rated at fifty watts. This unit usually works up to 500 miles. The voltage applied to the tubes is never more than 1,200. This comes from a small Newton auxiliary motor-generator, taking 12 volts, 40 amperes on the input side, and delivering even 1,500 volts if wanted. The motor generator weighs but eleven pounds.

"Used in conjunction with this second set is the wireless telephone unit. This will give clear speech up to eighty miles. I use it frequently. It is of especial value in landing, enabling us to be advised of ground barometric readings and temperatures with ease and promptness. This information is very vital in landing an airship on an even keel. There are twenty ballonets up in the hull of the ship, each filled with hydrogen. The lifting power of these varies markedly with changes in barometric pressure as well as temperatures. There are three tons of water up there also, and sometimes as much as 6,000 gallons of petrol (gasoline). So we have to know all about ground conditions before we begin to let out water and hydrogen and come down. A certain amount of hydrogen and water in the hull's containers may keep us in equilibrium at a given height, but to come down the quantity of both has to be lessened, that we may land evenly and without a jar that would damage some of the underparts of the ship. The radiotelephone is indeed handy in this connection.

"The third radio set is a spark

THE HEART OF THE WIRELESS ON THE NC 'PLANES

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transmitter, a 100-watt aircraft type being used. This works on 600 meters usually, and is for communication with mercantile craft. It has a safe range of 120 miles. But out on the Atlantic we once did as much as 300 miles, picking up Cape Race on the south shore of St. John's, Newfoundland, with no trouble at all.

"In this car there is also an intercommunicating telephone control board for speaking with any of the engine gondolas to the rear of the ship and other necessary points about the hull. We find this communicating set exceedingly convenient. When a ship is as long as this one—640 feet—one cannot always be running about after information. So here in the forward gondola we have this intercommunicating unit as a sort of nerve center for all the ship's activities."

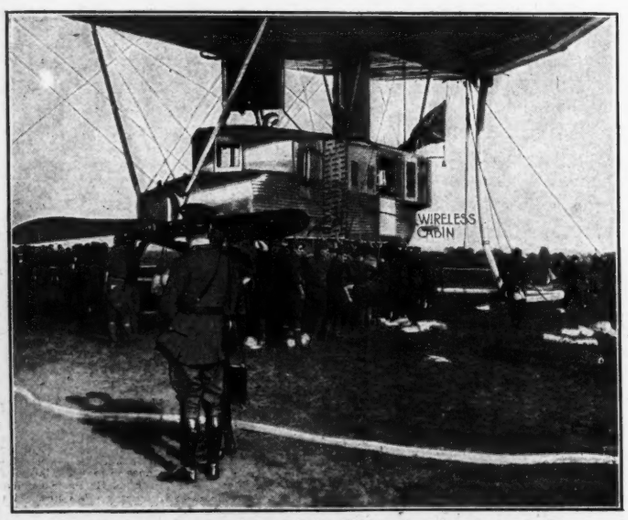
Lieutenant R. F. Durrant, of the Royal Air Force, radio officer of the R-34, holding the ship's spare 250-watt tube—valuable property

"For the sets four storage-battery units are carried," explained Lieutenant Durrant. "Two of these are of 12-volt, 80-ampere rating, and the other two have a capacity of 40 amperes at eight volts. A charging set for these batteries is carried on board. It consists of a Brolt dynamo, giving around 12 volts at its terminals. This is driven by one of the big propeller engines in the rear of this control car or gondola forward. Suitable shafts and gearing connect the generator to the engine.

"The airship has but one receiving unit. This was especially designed by the Experimental Department of the British Air Force. It consists of three British Thompson-Houston vacuum valves operated in cascade. Its plate voltage is 100. About 75 flashlight batteries in series provide this potential. The receiver has a 200- to 10,000-meter wave-length range.

"Two wavemeters are carried. One works normally 1,000 to 2,000 meters. A multiplying switch jumps this from 2,000 to 4,000. The other set is a larger model of the first-named, and operates up to 10,000 meters.

"You will note one especially interesting fact about this wireless cabin. A thick layer of hair felt on the inside walls shuts out practically all outside noises. Indeed, I have found that sitting in here, the ship seems to glide almost as noiselessly as an electric taxi over city asphalt. Of course most of the sound that may bother one comes from the engine in the rear of this particular gondola. When it runs I need my sound-proof room most.



Control car, or gondola, of the R-34, showing her wireless cabin. During her stay in the United States it was necessary for details of soldiers constantly to hold the dirigible to the ground in this way because of the changing winds

"All the sets use one aerial. It consists of 450 feet of 16-strand copper wire. A sturdy nine-pound lead weight hangs at the end of this cable. The weight is of streamline form, has tail fins, and all in all it looks very much like a miniature of the R-34 herself.

"It is but eight or ten inches long and about two inches in diameter. Tied to the end of the cable, it causes the latter to hang downward and to the rear in sort of a parabolic or similar curve.

"Do you see that aneroid barometer up there near the ceiling? It tells me how high up we are, since air-pressure increases as one nears the ground. When the barometer indicates that we are but four or five hundred feet from the ground, I begin to reel in that aerial. Otherwise the aerial would be likely to catch in a tree or something and be torn off.

"All through the voyage the radio-compass was of greatest use. It is a large framework affair up in the hull of the ship itself, and of common build. General Maitland's log of the voyage will tell you of a few specific instances out of a great many when we used the radio apparatus and compass to advantage." Here are excerpts:

Time, 11 A. M., the first day out, July 2. (Started from East Fortune, Scotland, near Edinburgh, at 1:42 this morning.) Position now: Two hundred miles out in Atlantic from northwest of Ireland.

We are in touch with East Fortune, Clifden (on the west coast of Ireland), and Ponta Delgada, Azores. Messages wishing us good luck are being received from Air Ministry, and H.M.S. Queen Elizabeth.

3:15 P. M. Durrant, the wireless officer, reports he has just been speaking to St. John's, Newfoundland. Rather faint but quite clear signals. As we are still in touch with East Fortune and Clifden, and have been exchanging signals with the Azores since reaching and passing the Irish coast, our communications seem good.

4:30 P. M. Tramp steamer *S.S. Ballygally Head*, outward bound from Belfast, destination Montreal, picked up our wireless on their Marconi spark set, which has a range of thirty miles only. She heard us but didn't see us, as we were well above and completely hidden by the clouds. She gave her position as latitude 54 degrees 30 minutes north, longitude: 18 degrees 20 minutes west, and reported as follows: "Steering south 80 west true, wind north, barometer 30.10. Overcast, clouds low. (Signed) Suffren, Master." They were very surprised and most interested to hear we were R-34 bound for New York.

5:30 P. M. Messages received from both H.M.S. battle cruisers *Tiger* and *Renown*, the ships previously sent by the Admiralty out into the Atlantic to assist us with weather reports and general observation. They reported respectively as follows: *Tiger:* Position 36 degrees 50 minutes north, 36 degrees 50 minutes west. *Renown:* 60 degrees north, 25 west. Cloudy. Visibility, four miles.

6.55 P. M. Wireless message from Air Ministry via Clifden states: "Conditions unchanged in British Isles. Anti-cyclone persistent in Eastern Atlantic—a new depression entering Atlantic from south."

12:45 P. M. next day, July 3. Durrant is speaking *S.S. Canada* on our spark wireless set, so there may be some chance of our seeing her shortly, as the sea is temporarily visible. The second wireless operator obtains the *Canada's* direction on our directional wireless, so we may know in what direction to look for her. All that we know at the moment is that she is somewhere within 120 miles. Captain David, in command, wishes us a safe voyage. We gaze through our glasses in her direction, but she is just over the horizon.

9 A. M., July 4. We are now over a large ice-field, and the sea is full of icebergs. The ice is blue-green under water with frozen snow on top. A message reaches us from the Governor of Newfoundland: "On behalf of Newfoundland, I greet you as you pass on your enterprising journey."

Landed 1:54 P. M. Greenwich mean time, or 9:54 A. M. U. S. summer time, Sunday, July 6, 1919, at Hazlehurst Field, Mineola, Long Island. Total time, entire voyage—108 hours, twelve minutes.

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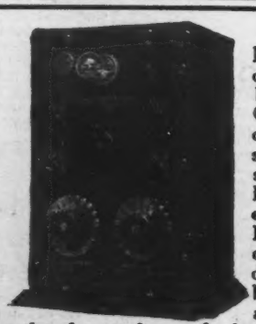

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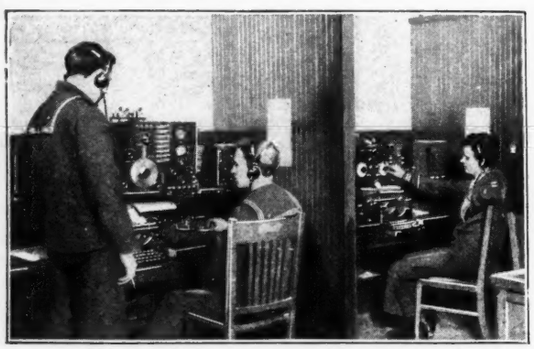
Workings of the Radio Compass

By A. K. Dyall

THE "loop" antenna is the basis of all radio compass action. It is nothing more than many turns of wire wound around a frame, usually square. This frame is sometimes made eight or ten feet on one side, though smaller sizes will work satisfactorily with enough vacuum valve amplifiers in the circuit.

The frame has a central axis, like a revolving door in a post-office or other public building. It is rotated about this central axis by hand until the operator hears a loudest sound in his receivers from the station whose steady sending he is listening for. When maximum sound comes, he knows that his loop is now "pointing" toward the sending station, just as a weather-vane points toward the direction from which the wind is coming.



Two operators' booths out of many at the large compass control station in New York. These men talk to vessels far at sea through remote control of near-by coastal radio stations

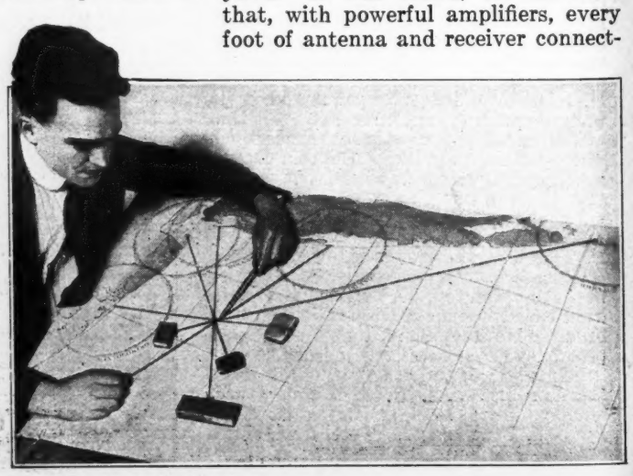
He usually has trouble, however, in telling just the place, in his rotating of the loop, where signals are coming in loudest, just as you have trouble in telling which of two or three church bells may be making the most sound when they happen to be ringing in your neighborhood. Being so nearly alike, you are unwilling to trust your ears.

The radio operator has the same difficulty. But if he turns his loop aerial crosswise to the direction from which signals are coming, like turning a weather-vane crosswise to the wind, the signals he is listening for drop out, or at least become very faint indeed. It is easy now, in his rotating of the aerial loop, to tell the point where signals become the very weakest. In fact, he can locate his loop within a fraction of a degree of the absolutely correct point.

Owing to a loop aerial's peculiar characteristics, he knows, as we said before, that the loop is now exactly crosswise of the direction from which the signals are coming. So, if he has previously affixed a pointer to his aerial shaft that is at right angles to the loop's plane, he knows that the pointer is at this instant pointing directly toward the sending station, or else directly away from it. In either case, the pointer is indicating a line that passes directly through the sender.

If a vessel at sea happens to be the sending station, it is easy to tell which end of the indicated line it is on, since it would naturally be out at sea and not at the end of the line that lies inland. In case the radio compass station happens to be dealing with a sender whose identity is wholly unknown (that is, whether it is at land or sea), there is another method of determining which end of the indicated line the sender is on—this method having to do with a rotatable loop in relation to a fixed aerial. The details of the method are somewhat complicated, however, and there is no space here to go into the subject.

As a result of the careful researches carried on by Kolster, Forbes, and Taylor and Dr. Austin, the navy's radio wizards, at the Bureau of Standards, the complete theory of radio compasses was worked out two or three years ago, in every particular, and some important facts brought out which had troubled experimenters for years. It was found, for instance, that, with powerful amplifiers, every foot of antenna and receiver connect-



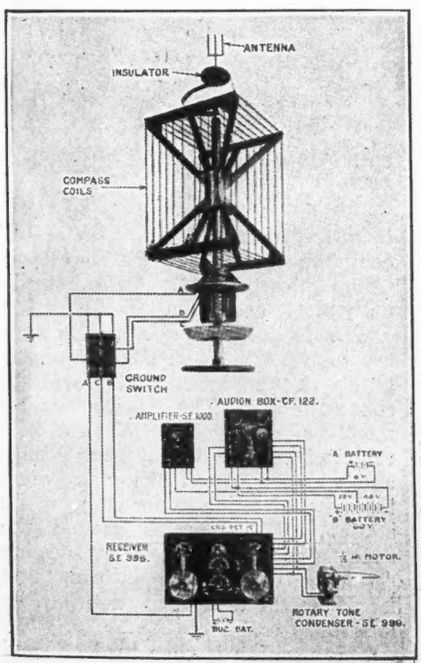
Radio compass operators, from their stations near the mouth of New York harbor, have just sent in to control station the radio compass bearings of a ship at sea, heard calling. By pulling strings out of holes in a map which correspond to the reporting operators' locations, the operator lays off the bearings given. He finds these all intersect at one point. This is the location of the ship. He radios the information to the ship

Far out on sandy capes and beaches, navy radio compass men sit in little houses like this listening for the calls of ships at sea. A copper floor shields sensitive apparatus

ing wire acts as an antenna, and must be covered with tinfoil or run inside a metal pipe or tube, or false indications will result. In the finest researches, the receiver was placed in a copper gauze room, and it was found that opening the door of the gauze room a fraction of an inch let in outside disturbances.

It was found that the direction indications of the radio compass were sometimes very inaccurate; for instance, in a station with a radio tower the coil would always have to point at the tower, and in some locations aboard ships no satisfactory results could be obtained. Experiment showed the compass to be right, but that the waves swung around when they strike any metallic or conducting object, and seem to come from an entirely different direction. See diagram, Page 118. In this respect they act much as water waves, or even light waves, going around an object. For this reason, compass stations must be placed far from danger of interference, and careful study and tests are made of each station after locating.

With a mass of accumulated knowledge as a guide, a number of radio compass stations were built along the



Detail of the apparatus within a radio compass station of the kind shown at the top of this column

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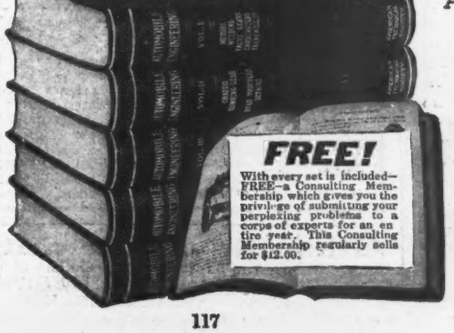
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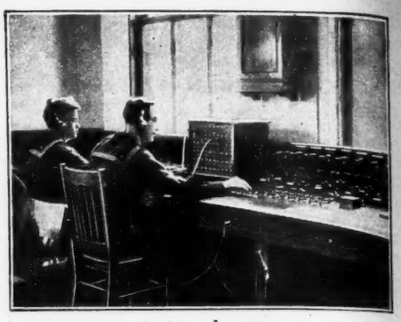
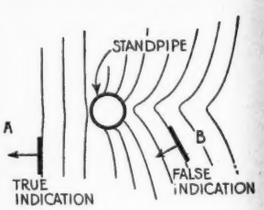


Another view inside the New York radio compass control station. The wires lead to compass stations on the beaches and capes

Atlantic coast. These have since become rather famous, and are proving very useful in guiding vessels into harbors in fogs, mists, or on dark, rainy nights. At New York harbor, for instance, stations at Montauk (east end of Long Island) and at Fire Island, Rockaway Beach, Sandy Hook, and Mantoloking, N. J., get radio compass bearings on any vessel that, entering the harbor, desires the service.

For instance, a ship calling NAH (New York) may be picked up by any of the stations, or by the Communication Office (on top of a tall office building downtown) directly. Within a few seconds the operator in this office proceeds to answer. By the shift of a plug his key may control the transmitter at any of the Navy stations within the district, such as Navy Yard, Bush Terminal, Fire Island, and other points. He tells the ship to send out a given call steadily for one minute, say.

Meanwhile the radio compass stations from Fire Island to Mantoloking, on the New Jersey coast, are getting compass bearings on the ship sending out the call. They rush their readings



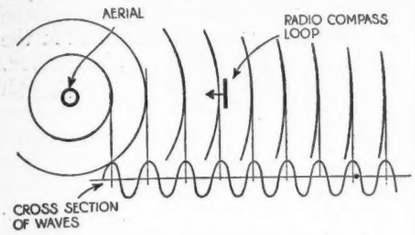
How standpipes, steel towers, or other metallic bodies distort radio waves. At *A* the compass is pointing accurately; at *B* it still faces the waves, but is pointing wrong

by telegraph to the man at the central compass control station at the Radio Communication office. He immediately plots the readings on a map.

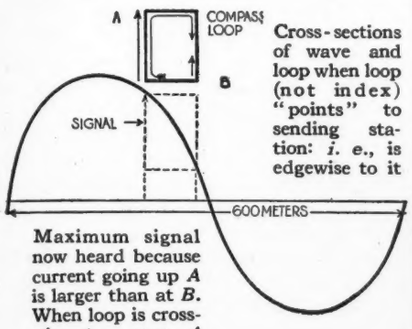
This is done by a clever but exceedingly simple device. The photograph at the bottom of Page 116 shows details. The device consists merely of a large-scale map set on a table with some disappearing strings and weights. Each string is swung into the direction reported from its station, and all cross around the average position of the ship, showing up very clearly the latitude and longitude of the ship desiring its location.

This position is then read off, and transmitted by again using "remote control" of the station nearest the ship. Time for this complete opera-

tion (or, rather, cooperation), six minutes; accuracy, better than thirty yards per mile of distance offshore. The ship receives the message, now knows its position accurately in spite of the fog or rain, and proceeds on its way securely, knowing exactly where to look for the Channel, and where it



How the radio compass loop faces an oncoming wave. Minimum sound now heard. Index points to sender



Cross-sections of wave and loop when loop (not index) "points" to sending station: *i. e.*, is edgewise to it

Maximum signal now heard because current going up *A* is larger than at *B*. When loop is crosswise to wave, *A* and *B* are alike

must go to keep away from reefs or other sources of danger.

The boys in the radio compass stations, who, by conscientious watchkeeping (a religious principle with the boys who wear the Navy "sparks") and accurate manipulation, make the system a success, are kept in touch with the whole system by a weekly bulletin edited by Lienheart Appleby, of the office of the Director of Naval Communications, and next to a generous "liberty" they prize most highly an item like this:

Extract from office report made by Commanding Officer U. S. S. *Bounding Bess:*

"At 2.30 A. M., April 29, 1919, while en route from Delaware Breakwater to Newport, R. I., a radio fix was requested and the following obtained:

Montauk Point,	193 degrees
Sandy Hook,	104 degrees
Mantoloking,	85 degrees

These bearings give the position of the ship as lat. 40 degrees .06 N., long. 72 .08 W.; the ship's position by dead reckoning was lat. 40 .08, long. 72 .07 W.

Notice that the ship's position by the compass readings was only a very small fraction of a degree off that given by dead reckoning—this last method of calculating being based on the ship's speed and course by ordinary calculation. That the compass readings and the dead reckoning result should agree so closely reflects unusual credit on the Navy men.

Much like lighthouses, radio compass stations along the coast are isolated and lonely. They, too, render a valuable service to ships at sea.

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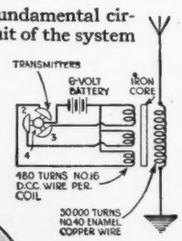
Telephoning Electrostatically—A New Radio System

MOST radio men are familiar enough with the ordinary circuits of radiotelegraphy. Many even have a good working knowledge of radiotelephony. But comes now Earl C. Hanson, of Washington, D. C., with a system quite unlike anything in the familiar run of circuits and principles.

His is an audio-frequency wireless system. The fundamental idea back of it is made clear by the small wiring diagram on this page. Briefly, the aerial is energized, and waves are sent out by a transformer directly controlled by ordinary telephone transmitters. It is almost as if a common telephone were provided with a little larger induction coil than ordinarily, and thereby made into a wireless telephone—surely a simple process. It should be stated, however, that in the Hanson system several transmitters, usually three, are used to control currents going to the primary of the transformer, each transmitter having its own winding on the transformer, but receiving the sound impulses from a man's voice, or a phonograph, or from some other source, through a common sound-feeding tube. See drawing on page 122.

That the apparatus "works" is demonstrated by the fact that Mr. Hanson has long had phonograph-operated wireless sets in operation, one of them being recently installed in the Walter Reid Hospital in Washington.

Fundamental circuit of the system

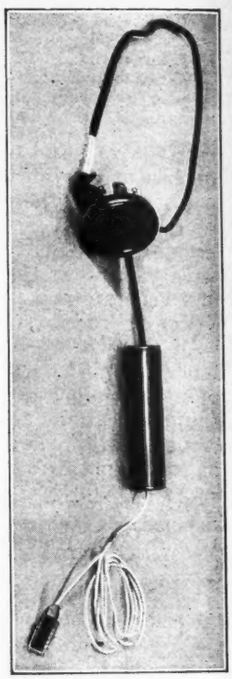


In this system a phonograph plays music or such other selections as may be desired into the transmitters of the set. The drawing on page 122 makes the details clearer.

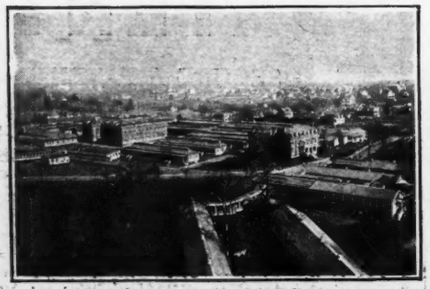
All that a patient has to do in order to receive is to attach one of the plain wire terminals of his ordinary telephone receiver to the springs of his bed, a steam radiator, or almost any other convenient metallic object. The other terminal of the receiver ends in a metallic handle which he holds in his hand. Thus the bed-spring, or any other metallic object, and himself form the "aerial" and the "ground" of his receiving circuit.

A curious fact is that the tighter the patient squeezes his metallic handle, the louder he hears the music. He can thus vary the intensity to suit his feelings at the moment. Moreover, the feature gives him something to experiment and play with. That the apparatus has to cleave to audio-frequencies is made obvious by the fact that the transformer has an

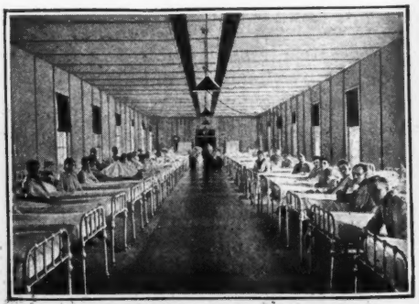
Earl C. Hanson and his electrostatic phonograph. Records are announced by his speaking in the transmitter



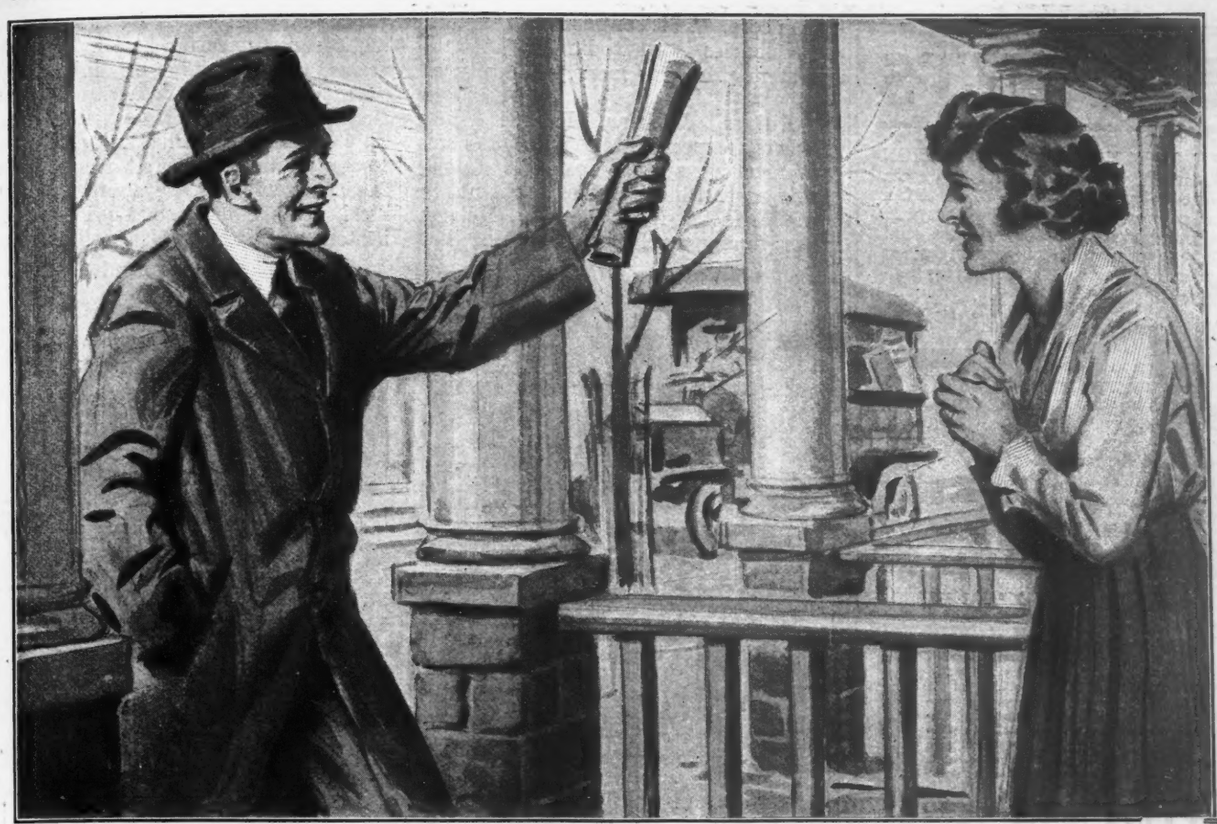
Patient's receiving apparatus. One receiver terminal ends at the metal handle; the other clamps to bed-springs



The Walter Reid Hospital in Washington where the apparatus is now working



Army convalescents listening to music wirelessly. Each patient has a receiver



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Why doesn't Your Boy Like His School

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It's an entirely different school story, a fascinating, absorbing story that your boy will read eagerly. He'll live it himself. It puts school in a new light. Gives him his bearings on what school really is for him. You owe it to your boy's future to put this story in his hands. School opens in September. *"High Benton"* starts with the September **American Boy**. Buy it at your news-stand, 20c, or subscribe, $2 a year.

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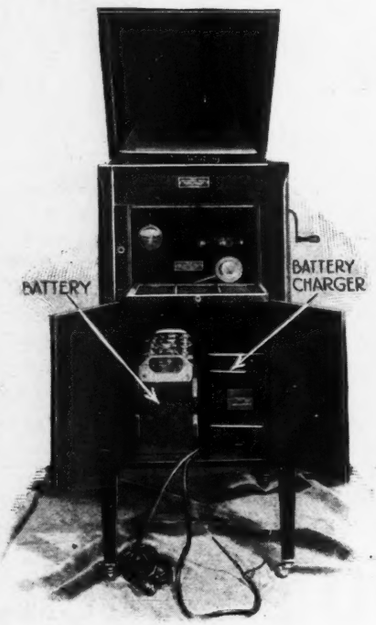
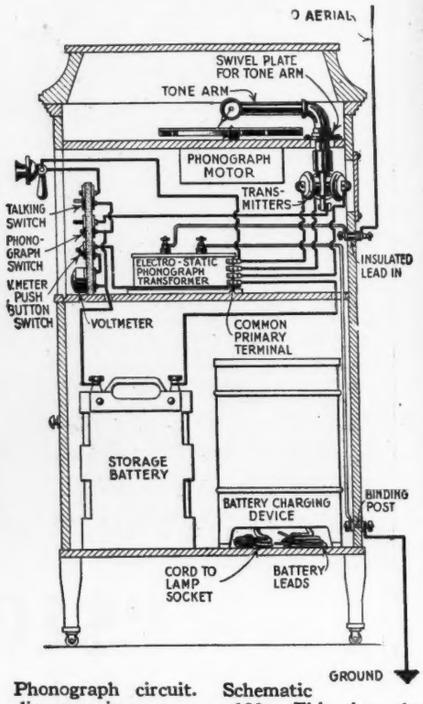
iron core. This confinement to audio-frequencies is what differentiates the system primarily from practically all others.

Edison, Dolbear, Ruhmer, and others, experimented with a communicating system somewhat along this general line years ago, but not in the perfected form that Mr. Hanson has finally evolved. The idea has within it possibilities in the way of audio-communication with moving trains, the guiding of ships into harbors, and of airplanes to destinations on landing fields. Some of these applications we shall take up in later issues. This is the first time fundamental circuits of the system have been published. The original work on the system was done in California.



The phonograph from which all the music comes. An attendant in the library operates it



Phonograph circuit. Schematic diagram given on page 120. This gives the gist of Mr. Hanson's electrostatic system

Coast Defense Units Now Use Radio

THE Army and the Navy are making good use of the radio experience gained through the war, experimenting and perfecting apparatus continually. Only recently the Army was successful in an especially noteworthy feat.

Flying nearly a mile high over Fort Hancock (Sandy Hook), N. J., recently, army observers in two airplanes directed the fire of twelve-inch guns on a target nearly fifteen miles out at sea. A third airplane at an altitude of nearly three miles observed the firing of the shots for visibility. The firing lasted an hour and fifty minutes. A total number of thirteen shots was fired.

Mostly the shots enclosed, or "bracketed," the target within a radius of 450 feet, which means that if the target had been a big battleship it would have been hit. The first shot struck two miles from the target, but after that the target was in an exceedingly precarious position, since the information radioed to the gunners by the men in the airplanes was so much to the point.

The experiment is considered as of much moment to the future coast defense of the United States, and for the protection of New York Harbor.

Current News Notes from the Radio Field

AIRPLANE mail service, which has been running for more than a year between Chicago and New York, is soon to be helped along by a chain of radio stations. There will be three at first—one at Cleveland, Ohio, another at Newark, N. J., and the third at Bellefont, Pa., this last to be completed by the middle of September, and the others shortly afterward. Each will be equipped with a five-kilowatt spark system set, and will have two towers, two hundred feet high and three hundred feet apart. Watch will be kept for the aviators, and information sent to help and expedite their work. The system will probably be extended in the near future to Chicago, Washington, D. C., and elsewhere.

The American Flying Club has established across the country a chain of radio stations capable of reporting regularly the progress of the army transcontinental fliers, and any others who set out on such a trip. Aviators will constantly be in touch with any city or town in the United States. In the event of forced landings or accidents, the district radio operator can summon assistance. Gasoline or other supplies can be rushed quickly to any spot by automobile. Stations within one hundred miles apart are in prospect.

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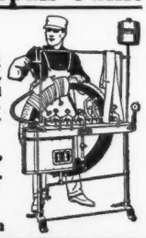

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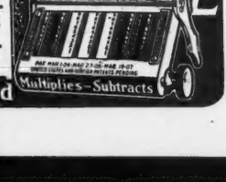

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Not Merely a Toy, It Teaches Magnetic Attraction

THIS little trick is exceedingly simple, and yet serves to fix in the mind the laws of magnetic attraction and repulsion more clearly than the reading of many text books.

It consists simply of a magnetized needle, dipped in paraffin and floated on the surface of a bowl of water, and a fairly strong horseshoe magnet. In magnetizing the needle, it should be

The uncanny movements of the needle are a source of wonder

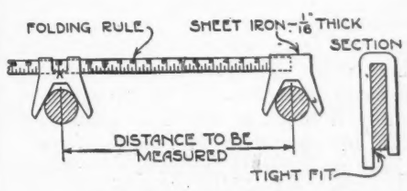
stroked, with one pole of the magnet, from the center towards one end. Then it should be stroked from the center towards the other end with the other pole of the magnet.

If these directions are followed, the needle will be uniformly magnetized, and the magnetism will last indefinitely. Now place the needle carefully on the surface of the water. If it is kept away from the edges of the bowl it will assume a north-and-south position, demonstrating the principle of the compass. If the horseshoe magnet is held anywhere within a foot or so of the floating needle it will have a decided effect upon it. In this manner the needle can be sent over the water in any direction, or reversed by simply turning the magnet to the proper angle.—C. W. HALLIGAN.

Measuring Distance between Revolving Shafts

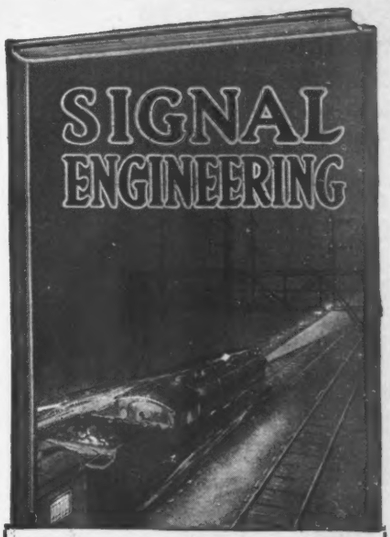
ANYBODY who has ever tried to measure a given distance between two revolving shafts will appreciate a method by which an accurate measurement can be obtained.

Two pieces of sheet-iron are cut and



The rule with the clamps attached is placed over the revolving shaft and an accurate measurement taken

bent to fit over a folding rule. The clamp at the left of the illustration is left open at the top so as to be able to see the dimensions on the rule. After the gages are cut they are easily bent until sufficient pressure to hold them is evidenced.—C. VAN BERG, Jr.



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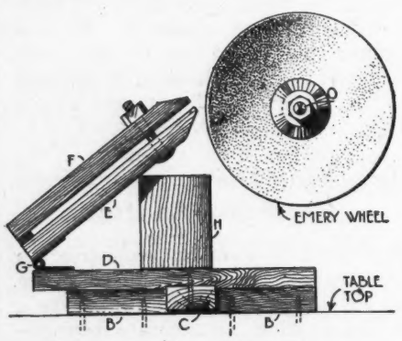
Making Old Hand Planes Serviceable

VERY good work can be done with old tools if they are in the proper condition. An old plane can easily be put into the best condition by the following method:

If the plane is a wooden one the bottom can best be trued up at a wood working shop, by using the buzz planer. If this is not possible a fairly good job can be done by hand planing with another plane. This being done the plane iron must be ground. A grindstone is good, but it must be true and straight across its face. An old plane usually has several nicks out of the edge of the iron, but it is not advisable to remove all of these the first time the iron is ground.

We will assume that the iron is in very bad condition and that an emery wheel of about one inch thickness is the only fast grinding machine available. The axis of this wheel, shown at *O* in the illustration, is located some 5 in. above a flat table. We should first obtain two pieces of hard wood 2 in. wide by 12 in. long and ½ in. thick. These should be screwed to the table 1 in. apart and parallel with the axis of the wheel, the ends of these pieces being shown at *B*. The piece *D* should then be made of the same material and about 4 in. wide and 6 in. long. The piece *C* is 1 in. wide and fits between the pieces *B*. Another piece, 6 in. long, should be set into the piece *D*, as shown, and screwed into place, the two pieces being at right angles to each other. The clamps for



With a contrivance of this sort you can keep your old planes in fine condition

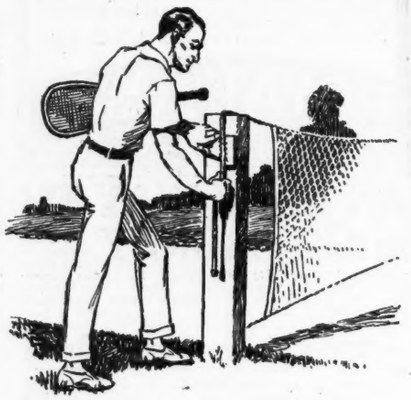
holding the iron must be mounted upon the piece *D* by the use of a tight fitting hinge at *G*. The jaws should be made of ½-in material. The piece *H* is simply a block of wood to hold the jaws in any required position. By raising or lowering the jaws any angle can be ground on the plane iron.

The machine should be operated by clamping the iron to be ground between the jaws and setting the block *H* so that the iron will just touch the wheel. The iron and holder should then be moved back and forth across the face of the wheel. As the iron is ground away the block *H* should be slowly worked back so that the iron may be gradually forced against the wheel. If a rounded edge is required on the tool it may be produced by rounding the pieces *B* and *C*, or by making *D* longer so that it may turn about a point somewhere to the left of *G*. The distance may be determined from the amount of curvature desired on the tool.—WALTER D. EMERSON.

A Good Way to Keep the Tennis Net Taut

TENNIS-PLAYERS experience great difficulty in keeping the net free from that annoying sag which makes it somewhat resemble the track of a roller coaster.

A simple but effective solution to this problem consists of two blocks of wood so notched that the net rope cannot slip through them and slacken up



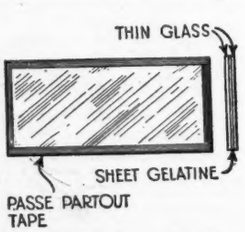
Notched clamps hold the rope securely until it is necessary to tighten or release it

the net. These are screwed to one of the posts, one being movable, so that it sets up against the other when the rope is inserted. This insures a tight and clean-looking tennis net.

This remedy may also be applied to the clothesline.—CLYDE KEITH.

How to Make Improvised Lantern Slides

IT is very often desired to throw upon the screen diagrams of statistics or colored lights. One very simple means of making slides for these purposes is to draw or write upon pieces of sheet gelatine with India ink and mount them between two pieces of thin glass and bind the edge with passe partout tape. With a glass-cutter such as may be obtained from any hardware store, there will be no difficulty in cutting glass of the proper size.



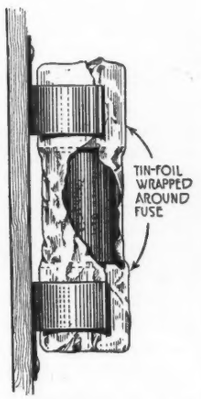
In an emergency this type of slide serves a number of purposes

Sheets of colored gelatine may be mounted in the same manner for the purpose of projecting colored lights.—FLOYD L. DARROW.

Tinfoil Used as a Substitute Fuse

WHILE taking an automobile trip, a short time ago, the headlights of my car were suddenly extinguished owing to the burning out of a fuse. We had no extra fuse blocks, and as the battery appeared to be unusually "hot" I was afraid of burning out the lamp globes if I attempted any sort of a direct current.

Suddenly it occurred to me that there were tinfoil wrappings on the package of cigarettes I carried. I removed this and wrapping the burn-out fuse block with several layers of tinfoil pressed it back into the clip connections. Turning on the head-light switch the lights came on, and we started upon our trip again without further illumination troubles.



In an emergency this is a valuable thing to know

Tests that I have made since have revealed that the tinfoil will melt and break the circuit at between ten and twenty volts, while an ordinary six volt headlight globe will seldom burn out with less current than eighteen volts.—JOHN E. HOGG.

Turn Old Automobile Tires into Shoe Soles

YOU will find that pieces from the sides of old automobile tires make very serviceable soles for shoes and will save money that would otherwise be spent for leather.

Tap your soles with old automobile tires. Such soles will outwear the ordinary leather

To make the sole, a square piece should be cut from the side of the tire where it is least worn. With the outside of the tire used as the bottom of the sole, stretch it over the shoe by means of four wires fastened to the corners of the tire strip, as shown in the illustration. The sole should now be tacked on, care being taken that the rubber does not bulge outward. Cut off the extra rubber even with the shoe and then polish. You will find that these soles last three times as long as the ordinary kind and if the job is neatly and carefully done no one will know the difference.—HOWARD DOMINICK.

Can You Answer these Questions on Shop Work?

THE skilled mechanic today is a specialist. He has no opportunity to build a complete machine or even a small part of one. His active work is carried along rather limited lines. But to make the best success in his work—to secure promotion to more responsible duties or to go into business for himself—it is absolutely necessary that he have a broad and comprehensive knowledge of machine work and shop practice. There is only one really feasible way for the mechanic to familiarize himself with other shop lines outside his own individual work—and that is to have specialists in all lines give him all they have learned in a form that will be readily accessible. There you have the reason for the famous standard reference work, called "Modern Shop Practice."

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A surface of cast iron is to be finished in one cut on a milling machine. The casting is 8 inches long and 5 inches wide. The milling cutter has a diameter of 3 inches and a width of 2 inches. How long will it take to do the work? Assume a feed of 2½ inches.

For what purpose is a magnetic chuck used?

How many processes for cutting gear teeth?

How do you determine the ratio of two gears, when the numbers of teeth are given?

The lead screw has a pitch of ¼ inch. What is the ratio of gears to be used to cut a screw with 18 threads per inch?

What determines the cutting speed in a milling machine?

Give a short description of the thermit-welding process.

What is essentially the first step in making any tool from a toolmaker's standpoint?

Why is it advisable to cut the threads of an adjustable tap somewhat smaller than the desired size for the tap to cut?

Under what circumstances would you consider it advisable to use a counterbore, rather than a drill when enlarging a hole? Why?

Why should undue accuracy never be indulged in when making drill, jigs and similar tools?

What is the practical way to test the temper of molding sand?

How does the riser on a steel casting differ from one for iron?

What are some of the precautions necessary in pouring a mold in order to obtain the best results?

How are the sides of deep molds vented when a flask is used?

What point carbon steel should be used for machine tools, milling cutters, drills and taps?

Why is it necessary to reheat large pieces after they have been hardened?

What must be the outside diameter of the original wooden pattern for the rim of a pulley with six arms the diameter of the finished pulley to be 30 inches and the width of face 9 inches?

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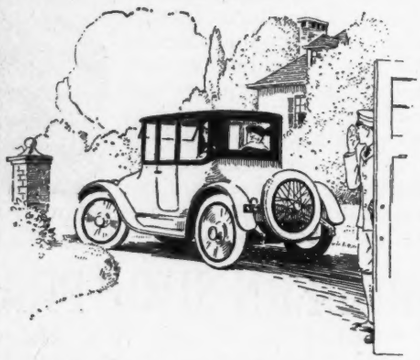
If Your Automobile Is Electric

By **H. Worthman, Jr.**

THE electric vehicle, whether truck or pleasure, is of necessity a city machine. The periodic recharging of the storage batteries makes it impossible for the car to travel very great distances from its base of supply, for the charging stations in outlying districts are few and far between.

The motive power of the electric car is storage batteries, the principal types of batteries in general use being the Edison and the Lead Plate Acid battery. The latter is widely used for all purposes on gasoline, steam or electric vehicles.



The electric car is only as good as its battery; take care of it

The construction of a battery is comparatively simple. It consists of a positive plate (of a reddish brown color) and a negative plate (of a greyish color), separated by a ribbed wood or hard rubber separator. The framework of a plate, which, in battery technique, is called a grid, consists of lead, and into this the active material is pressed. The active material is made up of red lead mixed with proper chemicals for the positive plate, and pure lead of a spongy character for the negative.

A number of these plates, sufficient to give the desired amperage, are connected to their respective terminals and put into a container or jar of hard rubber, after which dilute sulphuric acid and distilled water is added, which forms the electrolyte. The positive plate has a negative plate placed on either side of it.

The 110-ampere-hour cells, so much used on business cars, are connected in series in batteries of 40 to 45 cells to secure the full working capacity.

A simple explanation of a battery, when charging or discharging, is that the positive plate expels or breathes out the electrolyte on charging and soaks up or inhales it on discharging. This also explains why a battery will give greater mileage on a fresh charge. losing it when the car is left in the garage for any length of time.

The best way to ascertain the battery's condition is by the use of a hydrometer syringe. A fully charged cell will read about 1275 to 1300 points and a discharged cell around 1160.

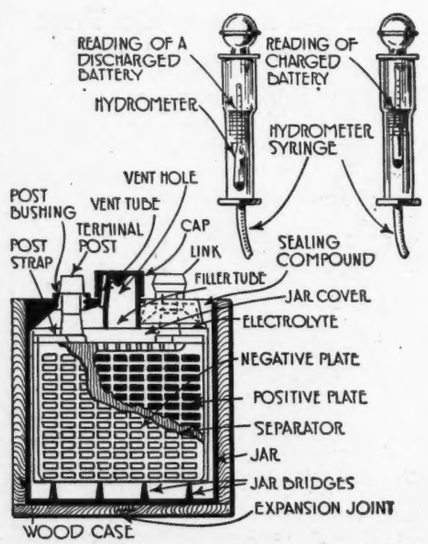
A common fault is to test a battery with a piece of metal, such as a wire, screwdriver, etc., getting a spark by a direct short circuit. Don't do this, for it causes the plates to buckle and crack. A voltmeter is the only instrument that can safely be used, other than a hydrometer. A cell will read about 2.2 volts on a voltmeter.

When charging a battery the electrolyte will heat up to a degree depending upon the rate of charging. This causes evaporation, and the electrolyte must be replenished with distilled water to its accustomed level.

All wiring on the car should be periodically inspected for damaged insulation, especially if acid has been spilled upon it by any mishap, for the acid eats through the wire insulation in a very short time. Bear in mind that the electrical power in a battery is limited, and everything done to conserve it will mean a saving of expense and labor. All movable contacts should be cleaned frequently, for dirt, grease, and foreign substances prevent the controller working properly and prevent good contact being made, which wastes current. The gearing and wheels should be looked over and greased about once a year.

Dragging brakes, poor contact, under-inflated tires, also cause a surprising amount of trouble.

Be sure to keep the battery solution above the plates. Do not let the temperature exceed 100° F. when charging. Do not let the battery stand idle when discharged. Keep the battery and all its connections clean. Follow manufacturer's instructions when charging.



The storage battery is supposedly a complicated contrivance, but it's very simple to understand

Use the hydrometer to ascertain the density of the solution.

Avoid excessive use of current.

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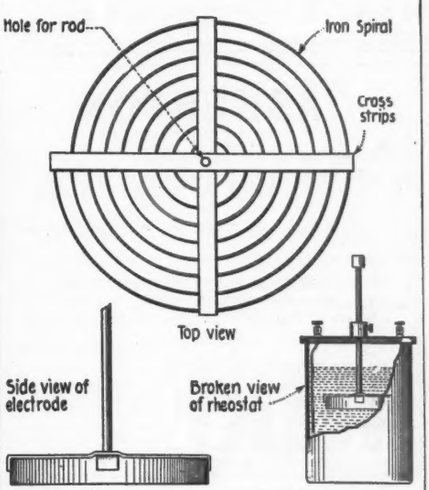
Improved Electrode for a Water Rheostat

THE form of water rheostat usually employed for regulating current strength is made from a large glass or porcelain jar with horizontal electrodes. A rheostat employing vertical electrodes is preferable for the reason that any gases formed are readily released and polarization of the plates is thus avoided.

Desiring to use a rheostat with horizontal plates on account of the small space it occupies, the writer devised a form of horizontal electrode that allowed easy escape of the gases.

A strip of galvanized iron, 1 in. wide, was bent into a spiral, allowing ½ in. of space between each turn. Two strips of the iron are then crossed on the spiral and soldered to it in several places. The rod is fastened to the cross strip by drilling.

With this construction the action of the rheostat is greatly improved,



Vertical electrodes in a rheostat permit the gases to escape and occupy but little space

the circulation of the electrolyte keeping the solution cooler and, by carrying off all the gases, prevents polarization.—THOMAS W. BENSON.

Correcting Engine Starter Trouble

A LARGE proportion of engine starter and lighting generator trouble is due to high mica on the commutator. This is especially true after a car has been in service for some time and is more noticeable in the generator than the starter.

The copper wears faster than the mica (mica is the insulation between the copper segments) and therefore, after a time, the mica will protrude above the surface of the copper and prevent the brushes from making good contact.

The usual symptoms are—dirty commutator, rapid brush wear, squeaking, chattering or vibrating brushes, which results in no charging current, generator fails to supply enough cur-

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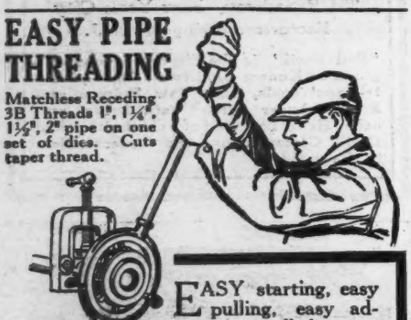

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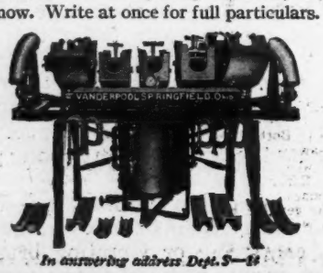


In answering address Dept. S—14

WM. VANDERPOOL CO., Springfield, O.

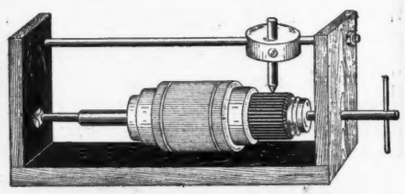
rent to keep up the battery, consequently, dim lights and a dead starter.

This high mica should be carefully removed with a dependable instrument. The tool shown in the illustration performs this work very satisfactorily. It is inexpensive, the base and ends being constructed of 1 in. oak, while an ordinary machine screw or bolt can be conveniently utilized for the centers on which the armature rotates, and the centers secured in place with lock nuts.

The bar, or guide, on which the cutter operates, can be of ½-in. cold rolled steel, while the cutter should be made of ¼-in. drill rod.

The point of this cutter is ground sharp, like a parting tool on a lathe, or planer, and adjusted to the thickness of the mica between the copper bars.

The armature is rotated on these centers and the cutter is operated



Automobile lighting and starting troubles are frequently due to high mica on the commutator. This machine remedies the trouble

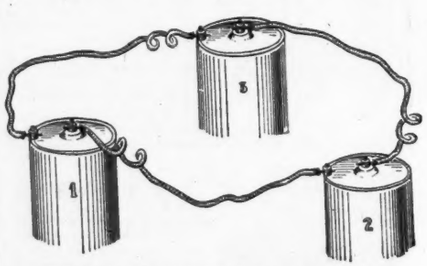
backward and forward in the same manner as a planer or shaper tool.

Great care should be exercised, so that all the mica is removed, especially close up alongside the commutator bars.—D. C. GRINDELL.

Three Worn-Out Dry-Cells Make One Good One

IF you have three old batteries and need one good one, connect them up as shown in the sketch and all the current in them will run into No. 3 battery.

Connect the zinc in battery No. 1 to the zinc in battery No. 3. Connect



When connected in this manner all the current flows into No. 3 battery

the carbon in battery No. 2 to the carbon in battery No. 3. Connect the carbon in battery No. 1 to the zinc in battery No. 2. Leave the cells connected in this way for half a day and the third battery will be as good as when new. When carrying out this method, it is, of course, desirable to choose the best cell of the three to resuscitate.—DUARD SCOTT.

First Aid for the Chemical Laboratory

WHEN handling chemicals to any extent it is prudent to have at hand preparations to prevent harmful effects should corrosive acids or alkalis get into the eyes or on the hands. A neat shelf can be made as shown in the illustration and used only to hold these first-aid solutions, which are made as follows:

Body—Acid Burns: Saturated solution of Sodium Bicarbonate.

Body—Caustic Burns: Distilled water, 95 parts; Acetic Acid, 99 per cent C.P., 5 parts.

Eye—Acid Burns: Distilled water, 95 parts; Sodium Bicarbonate, 5 parts.

Eye—Caustic Burns: Distilled water, 98 parts; Acetic Acid, 99 per cent C.P., 2 parts.

All quantities by volume.

When the body is burned by the spilling or splashing of a corrosive

With a safety-first shelf the chemist is always prepared for accidents

solution remove clothing from the part and apply the proper solution freely.

When acid or caustic splashes in the eye an eye cup can be used for applying the solution or pour into the eye holding the lids open.

Quick action in such cases often prevents much pain and inconvenience and one is always prepared for the worst.—THOMAS W. BENSON.

A Sound Magnifier for an Electric Bell

SOMETIMES the electric door-bell is so placed in the back part of the house that it can hardly be heard. A larger bell means additional batteries and an added expenditure. To do away with this expense the writer made a megaphone out of cardboard, which he placed over the bell on the wall, deflecting the larger end down-

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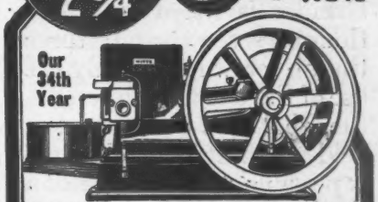

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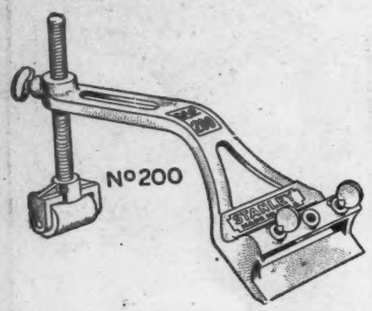
Stanley Tools



Stanley Cutter and Chisel Grinder

The STANLEY CUTTER AND CHISEL GRINDER is a device for holding Plane Irons, Chisels, and other similar cutting tools that they may be ground or honed to any desired angle or bevel, insuring an accuracy that is very difficult to obtain when the tool is held in the hand.

The tool to be sharpened is rigidly held in the Grinder by thumb screws, and may be given any desired angle by means of the large screw attached to the roller frame, which raises or lowers the main body.

As shown in the cut the Grinder is fitted with two thumb screws and three thumb screw holes. By the use of the two thumb screws, the tool to be ground is held much more firmly than is possible with the use of a single screw.

The Sharpener is made entirely of metal, all parts being nickel plated.

Special circular upon request

STANLEY RULE & LEVEL CO.
NEW BRITAIN, CONN. U.S.A.

ward at the angle towards the center of the room. This enabled even a deaf person to distinctly hear the bell

A megaphone set over the doorbell would even make a deaf person hear

and it could also be heard with perfect ease from all parts of the house.

This ingenious arrangement lends itself to outside bells to even better advantage. It could be used on outdoor telephone bells and yard bells, for instance.—JAMES M. PURCELL.

Extracting a Cork from the Inside of a Bottle

WHEN a cork slides down inside a bottle it is very difficult to get it out unless one has the necessary tools, and they are not always available.

A good way to extract it is to grease the neck of the bottle with vaseline, then hold the bottle under cold water.

When the bottle is as cold as possible spear the cork with a hat pin, or even shake it until it blocks the neck of the bottle and sets straight with the neck. Then gradually heat the bottle or pour

Pour hot water on the iced bottle and out pops the cork

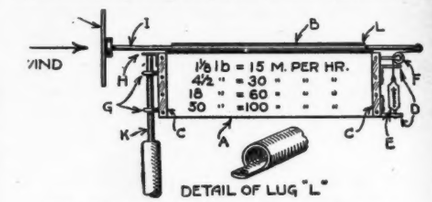
hot water over it and the expanding air will generally force the cork out with a slight pop.—VICTOR H. TODD.

A Gage that Tells How Hard the Wind Blows

AS a companion to the weather-vane every dweller in rural districts should have a wind-pressure gage by which he can determine the velocity of the wind as well as its direction. The one shown here is very simple in construction and operation, will estimate, roughly, the wind's velocity, and can be read at a glance.

The vane *A* is constructed of a ⅞-in. board 36 in. long and 8 in. wide. Groove out the top edge with a gouge and fit a length of smooth bore pipe *B*, 1 in. inside diameter, along this groove, fastening the pipe to the wood by means of a lug at each end, as shown. The vane is kept from warping in the weather by a piece of strap iron *CC*, bolted through at each end.

At one end secure two angle-irons *DD* sufficiently far apart to take a common spring scale *E* when extended



This wind pressure gage is easily taken off and stowed away when not needed

the full length of the scale. Just above the top angle-iron insert a small pulley *F*.

Two heavy screw-eyes *GG* are then inserted in the opposite end of vane beneath a third angle iron *H* at the top of that end. The rod *I* is of round ⅞-in. oak or other tough wood and is 5 ft. long.

On one end of the rod is fastened the pressure-board *J*, which can be made of wood or sheet iron as desired. A block on one side of the board is furnished with a hole which makes a driving fit over the rod. This board is 12 in. square, having an area of 1 sq. foot or 144 sq. ins.

Slip the rod through the tube, insert a screw-eye in the other end of rod and connect to the ring of the scale by a stout, flexible cord passing over the pulley. When the pressure board is free from pressure, about 15 in. of that end of the rod should project from the tube, while the cord should be adjusted so the scale reads at *O*.

Provide a suitable round iron rod, for a spindle, which fits through the screw-eyes *GG* and bears up against the angle iron *H*. Mount the complete apparatus upon a post in a clear space where the wind blows free.

Before assembling the parts, give the rod a thorough soaking in hot paraffin and give the vane several coatings of linseed oil.

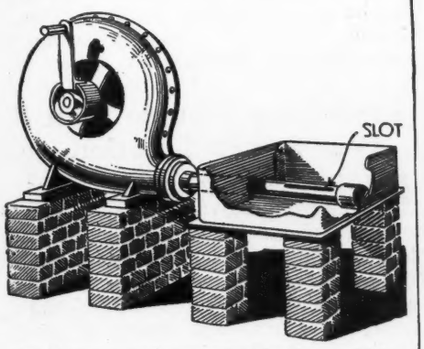
An approximate pressure and wind velocity scale can be painted on the vane as suggested.

Such an instrument will be found handy to assist one to determine weather conditions.

A Home-Made Forge and Blower

THAT "necessity is the mother of invention" is proven by the ingenuity displayed in this contrivance, which was made to replace a high-priced piece of machinery.

A discarded blower was used. A pipe with a slot cut in it was screwed to the exhaust of the blower. The end of the pipe passed through the hole of a container made from material found in a scrap pile. When completed coal was placed in the container.



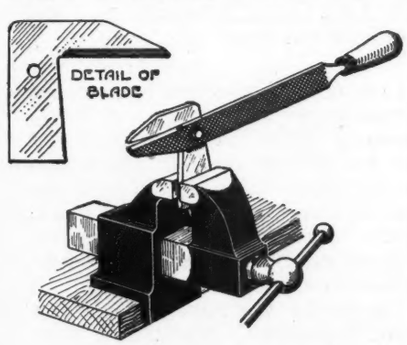
The blower produces an intense heat which will quickly bring the steel to a glow

A handle was then attached to the pulley wheel of the blower, and the assembled apparatus mounted upon a brick base, as shown in the illustration, thus making a cheap and effective forge.—ERNEST SCHWARTZ.

You Can Make This Vise-Shear without Cost

THIS simple, home-made device is one that is well worth the making, and as it is made from a piece of flat steel and an old file it costs only one's spare time.

The stationary blade is shown in detail and is made from a piece of ⅜-in. flat steel. The moving blade is made by drifting a hole through a flat file that has been previously heated to a cherry red; then the file teeth on the cutting side are ground off and the cutting edge ground on. Now simply assemble the parts with a bolt and nut and the tool is complete.—CHARLES H. WILLEY.



An old file and a piece of flat steel makes this handy vise-shear

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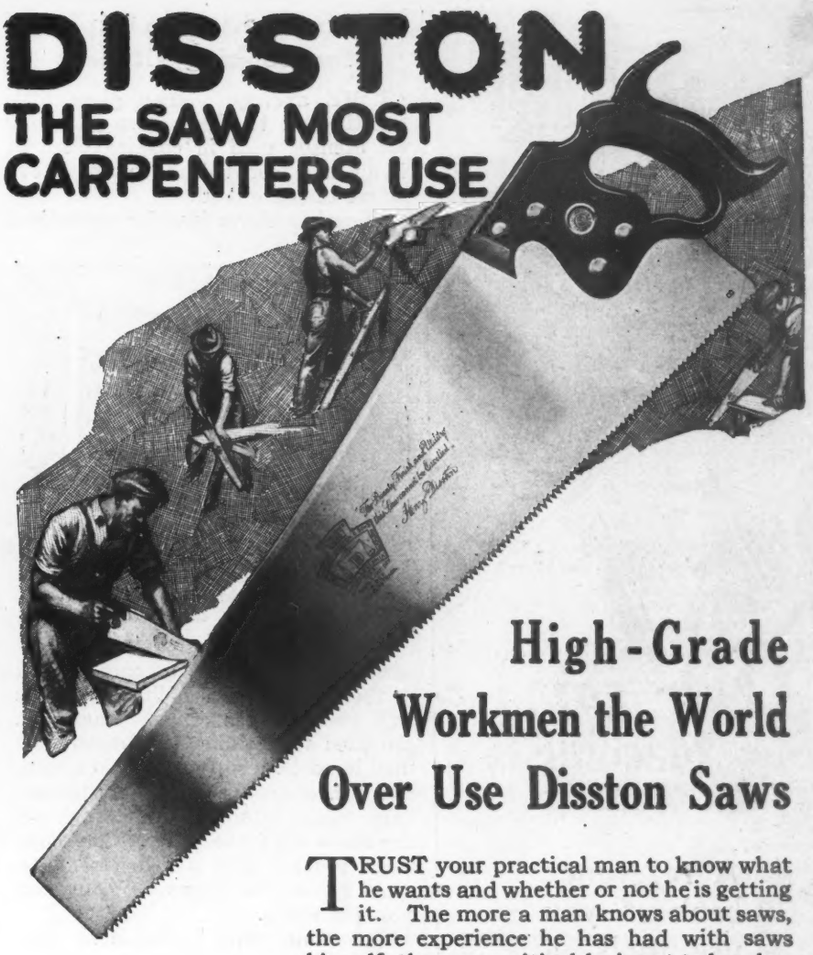

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Brown & Sharpe Mfg. Co.,
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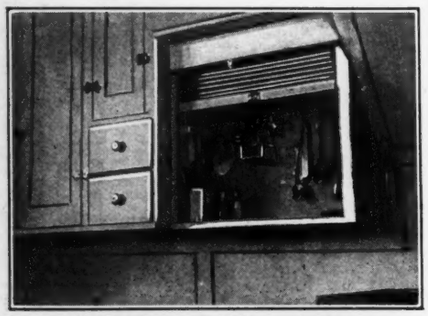
A Compact Kitchen Cupboard for Cooking Utensils

THE average woman gives little thought to the matter of having all utensils used in cooking close at hand and convenient to the stove where they are used.

Here is a clever idea for convenient



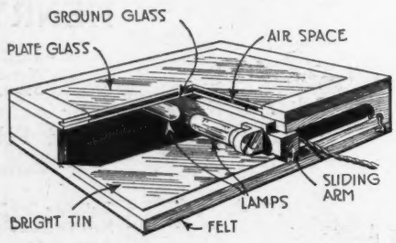
"A place for everything and everything in its place," is the slogan of this easily made cupboard

arrangement. The cupboard shown in the illustration is built against the wall beside a gas range. Racks are provided for holding the implements used in cooking so that the housewife, can, if necessary, reach them with one hand while attending to things on the stove with the other. The cupboard is made with a rising front, to avoid having the doors swinging out over the stove.

The rising front is simple in construction and is easily made. Strips of half round molding are cut to proper length and glued to a piece of oil cloth. Tacks are used to insure the strips adhering stoutly to the oil-cloth. The channel in which the rising front slides is made by laying out the pattern on a piece of board and sawing it with a band-saw, afterwards nailing the sections to another solid piece of board. Care must be taken to leave plenty of room in this channel as the front must fit very loosely in order to avoid binding, otherwise it will become jammed.—W. O. MOORE.

Here Is a Transparent Drawing-Board

A UNIQUE and practical device is the drawing board illustrated. It is designed for copying drawings



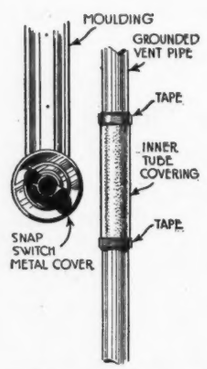
It helps the draftsman or tracer to get his much wanted clear copies

on opaque paper and will even take Bristol board, through which pencil drawings will show clearly.

A wide frame is constructed of white pine, carrying a piece of plate-glass set flush with the top. The top is hinged to a base of the same material which has been lined with bright tin. A sliding bar carries two showcase lamps whose light is concentrated on the under part of the drawing by the tin. Ventilation and protection from overheating are provided for by ground glass underneath the plate glass with an air space between the two. The frame has a piece of felt glued to the bottom so that it may be placed upon a polished table without danger of scratching the surface.—HERMAN NEUHAUS.

Remedying Trouble from Poor Switch Location

THERE are many instances where snap switches with metal covers, or open knife switches, are placed in close proximity to grounded pipes. If the wire feeding the switch happens to be the outside or "live" side of the circuit there is always danger of getting a nasty shock in turning the switch on or off, as the hand may come in contact with the surface of the pipe. This condition often exists in residences, and while the shock from the lighting voltage is not likely to be serious it is unpleasant to say the least especially to the women-folks. In planning a wiring installation such conditions should be avoided, but if they cannot be avoided, care should be taken to have the wire feeding the switch of the same polarity as the grounded object, that is, it should be fed from the grounded side of the circuit. In the instance cited herein the snap switch with a metal cover was fed from the "live" side of the line, and was mounted at the corner of a wall where a grounded vent pipe was but an inch or so from the switch cover. There was a sink close to the vent pipe and the women folks of the family often turned the switch on with wet hands and, of course, received a shock in doing so.



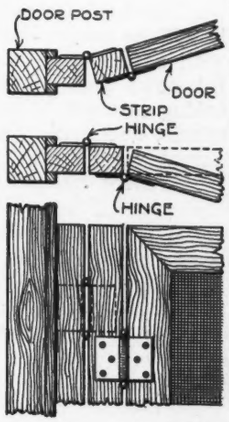
Rubber casing around the pipe near the wall switch does away with accidental shocks

The trouble was remedied as shown in the illustration. A section of inner tube was cut open, stretched tightly around the pipe and taped neatly in place at the top and bottom. This rubber insulating cover was neater and possessed better insulating qualities than several layers of friction tape. If the pipe happens to be part of the heating system a covering of fiber will be better on account of the heat.—J. A WEAVER.

To Make a Door Open Both Ways

IN a great many homes it is desirable to have a swinging door that will open either way. Yet the price of double-acting hinges is three times what it used to be and something that will eliminate this cost is welcome.

A strip of hard wood about 1 in. thick and as wide as the door, is hinged to the door-post exactly as if it were the door itself. The door is hinged to this strip, but with the hinges on the other side of the strip.



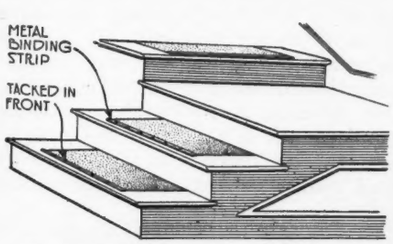
A double-acting screen door eliminates the danger of overbalancing on narrow steps

When the door opens one way the strip acts as part of the door-post and one pair of hinges stay closed, while when it opens the other way, the strip acts like a part of the door and the opposite pair of hinges stay closed.—VICTOR H. TODD.

Noise Eliminators for the Staircase

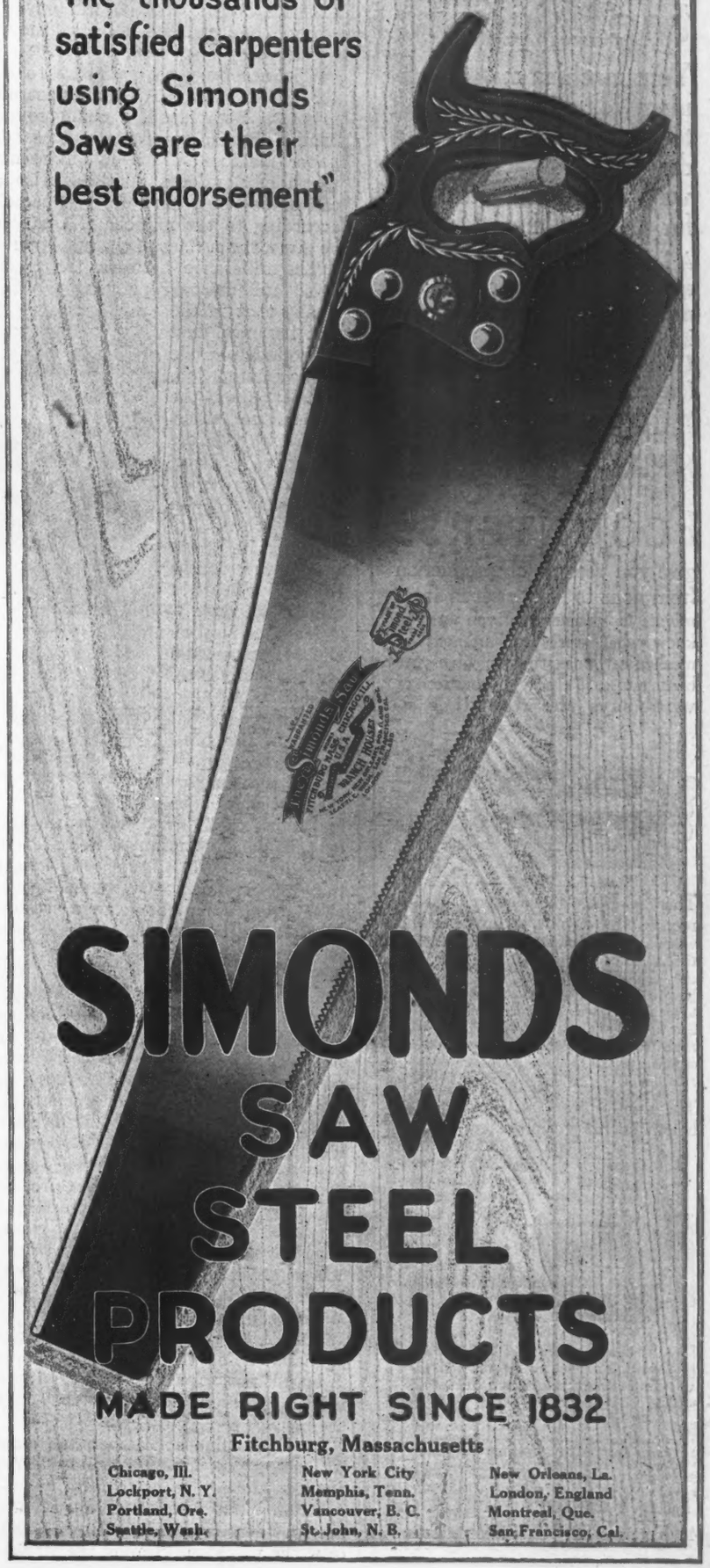
A BARE stairway is a noisy adjunct to a home where there are young children, and one which has a waxed finish makes a constant source of danger that they will slip and get hurt. The ordinary stair carpet, while deadening sound and preventing slipping, is difficult to clean, usually being left down for such long periods that it is not sanitary. One mother has invented pads to cover the middle of each step.

The stairs are of natural oak and the pads of "granite" or speckled linoleum of the same shade. They are fastened at the front edge with binding metal and fit snugly at the back against the riser. The linoleum deadens sound, is elastic, easy to sweep or to dust with a damp cloth, and its appearance is very neat. Though fastened only at their four margins the pieces lie flat and they are easily lifted when it is necessary to sweep the floor.—AVIS G. VESTAL.



No necessity now to creep up the stairs at 1 a. m. with your shoes in your hand

"The thousands of satisfied carpenters using Simonds Saws are their best endorsement"



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What Says the Record

Your machine may be running well so far as eye can tell, but in an hour or a day the output may be way *below* the standard for that machine.

A little difference in operating speed or in mechanical adjustment makes a big difference in results, and only a **Veeder Counter** can *measure* the difference as your machine works.

Veeder
COUNTERS

give you records of production from hour to hour or even from *minute to minute*, so if you want to know what operating methods or mechanical adjustments give the best results, it's only a question of **what says the record!**

This Set-Back Revolution Counter records the output of any machine where a shaft revolution indicates an operation. Counts one for each revolution, and sets back to zero from any figure by turning knob once round. Supplied with from four to ten figure wheels, as ordered. Price, with four figures, as illustrated, $8.50. A similar model to count *reciprocating* movements, as of punch presses, $10.00. (*Cut less than ½ size.*)

The small Rotary Ratchet Counter below counts reciprocating movements of the lever, where these indicate machine operations. When lever is moved thru an angle of 40 to 60 degrees, the counter registers one. A complete revolution of the lever registers ten. A most adaptable counter for recording the output of small machines or experimental work in *developing* machines. Price, $1.75. (*Cut approx. full size.*)

See the Veeder Booklet for counters suitable for practically every machine and hand-counting purpose. Copy is yours on request.

The Veeder Mfg. Co.
44 Sargeant St., Hartford, Conn.

Cleaning and Painting the Motorcycle

As expert painters are booked up far in advance it is reasonable to expect that if we want our motorcycles cleaned and painted we must do it ourselves.

The necessary requirements to do this are not many. A 1-in. flat enamel brush, a 2-in. brush, a small round enamel brush, two sheets of sandpaper (medium and fine) and five cents worth of powdered pumice. Also a can or two of a hard drying enamel, according to the number of coats to be given the surface of the machine.

The difference between the trade finish and amateur painting is principally that in the first instance, dust is excluded while in the amateur job, it falls upon the wet enamel, sticks there and robs the surface of its gloss. Accordingly all care should be taken that the painting is done where there is the least possible amount of dust.

It is assumed that the renovation is to be carried out in the machine's original colors

New brushes should be soaked for 12 hours or so, washed with Ivory soap and allowed to dry. This is to secure the bristles. Take the coarser sheet of sandpaper and work each brush backward and forward for five minutes in order to wear down any bristles slightly longer than their fellows. Of course, if you have or can borrow some good brushes which have been in use for some time so much the better.

Now to business. Remove the wheels, tank, saddle and small fittings. It does not matter about the handlebars or the engine, but these must be thoroughly clean, if dust is to be kept out of our painting. With a hose, or bucket and rags, clean every particle of mud from the frame, taking care that none remains inside the mudguards. Be liberal with the water; it is the cheapest part of the process and can be quickly wiped from bright fittings. After drying with a cloth, level down all chipped places with the coarse sandpaper and then go over the whole frame with the finer grade. If the chipping is very bad it may be advisable to give these places a coat of enamel before the rubbing down, but it ought not to be necessary with a machine which has been carefully used.

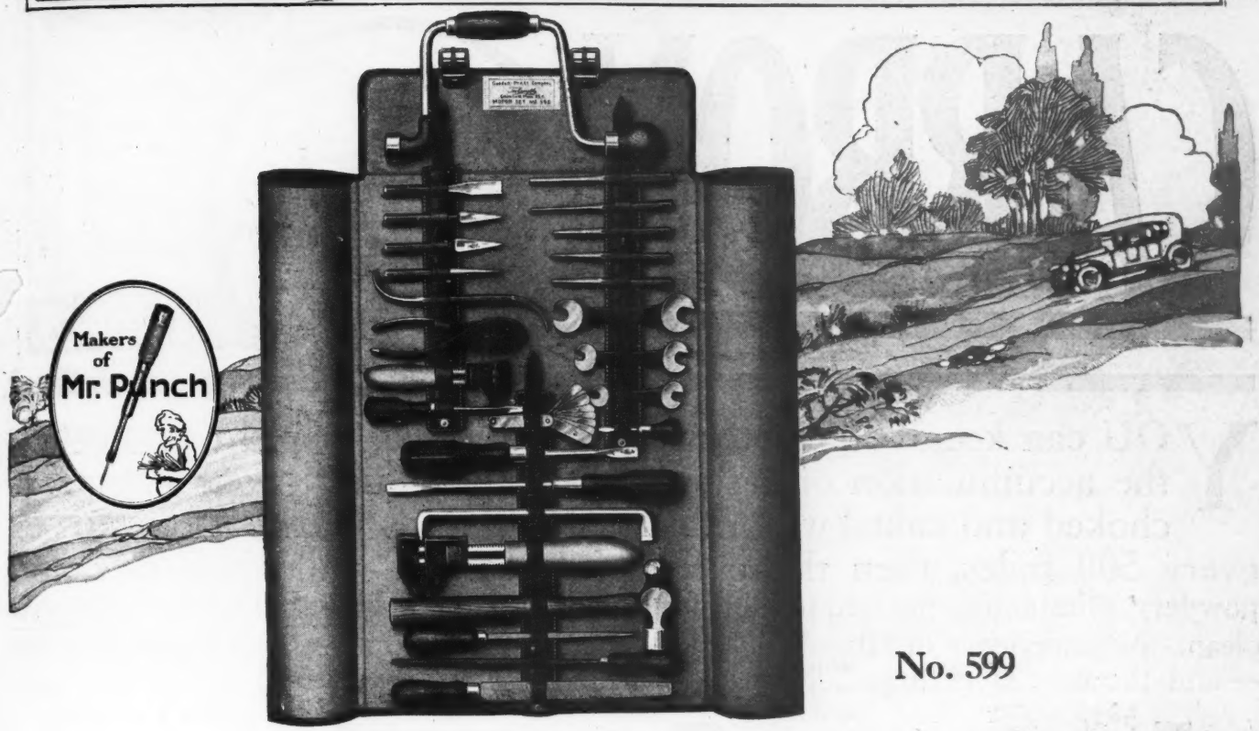
After the fine sandpaper has done its best, wrap a duster around some wool or clothes, so as to form a pad. Moisten it in water and dip it into the powdered pumice. Rub gently over the machine, keeping the strokes all one way, until the whole surface shows a lustreless evenness. Sponge it off, taking care to remove all the pumice powder, and transfer to the apartment previously prepared. Treat the wheels and the tank in a similar manner, making sure the colors chosen match the originals. If the tank has the baked color finish now so popular, it will be preferable to fill scratches with a fine brush and paint. Then rub down these places very carefully, taking care not to injure the maker's efforts, and apply one coat of transparent varnish.

The mere application of the enamel is simplicity itself. At first attempt nearly everybody puts it on too thickly, with the result that it drains to the lower edges and upon drying forms a solid ridge, leaving the upper portions of the work exceedingly thin. Dip the brush into the color only about a third of the distance up the bristles and apply in quick strokes over definite portions of the machine, finishing with short, light strokes all going one way. On mudguards and large surfaces generally the strokes should be downward, and on the frame tubes they should finish in the direction of the next portion to receive attention. On no account go back after once having left an area—this is positively fatal, and for this reason it is essential to do your best on each section before passing on to the next.

The several portions may now be left to dry, and in 24 hours they will be ready for assembling, but to harden properly will require about four days in damp winter weather. To make a thorough job of the process another coat should be given after repeating the rubbing down with powdered pumice. As a result of the second coat the brilliance will last twice as long, and it takes very little extra time.

Side-cars, if coach-finished and not too far gone, should have only two coats of varnish put on as thinly and evenly as possible, allowing two days for the first coat to dry. In varnishing, evenness of application is even more imperative than when laying on the enamel, failing which a tendency to patchiness is noticeable. Should the paintwork be badly scratched, rub down with the pumice and give two coats of enamel of a shade as near as possible to the maker's choice.

GOODELL-PRATT
1500 GOOD TOOLS



No. 599

Friends of the Motorist
Motor Set No. 599

PREPARED for the man who guards against long delays on the road, for the enthusiast who matches the quality of his car with the quality of its extras, for the owner who cuts repair expense by the little mechanical attention he gives to his car.

This set contains twenty-seven tools and is suitable for repairing all ordinary road troubles. The tools come in an extra heavy leather-bound canvas roll and each tool is held firmly in place by broad, strong leather straps.

Motorists can feel proud of this kit, for Goodell-Pratt skill and care have entered into its production. The great demand for this high-grade Motor Set proves its value.

Your dealer will be glad to show you how complete and handy this set is, or a more detailed description of this or any of the other 1500 Goodell-Pratt Tools will be sent upon request.

Motor Set No. 599 contains

No. 82 Rim Wrench	No. 416 Pin Punch	No. 466 Center Punch	No. 909 Screw Driver, 3-inch
No. 278 Screw Driver	No. 455 Cold Chisel	No. 474 Double End Wrench	No. 909 Screw Driver, 7-inch
No. 359 Thickness Gauge	No. 457 Cape Chisel	No. 475 Double End Wrench	6-inch Three Square File
No. 366 Offset Screw Driver	No. 462 Half Round Chisel	No. 476 Double End Wrench	8-inch Flat File
No. 367 Screw Driver, 4-inch	No. 463 Solid Punch	No. 479 Cotter Pin Puller	8-inch Round File
No. 376 Combination Pliers	No. 464 Cup Punch	No. 481 Adjustable Wrench	16-ounce Ball Pien Hammer
No. 413 Pin Punch	No. 465 Prick Punch	No. 484 Adjustable Wrench	

GOODELL-PRATT COMPANY *Toolsmiths* GREENFIELD, MASS., U. S. A.

GOODELL-PRATT COMPANY Greenfield, Mass., U. S. A.

PREVENTS ACCUMULATION OF CARBON

YOU can keep your motor snappy and full of "pep" by ***preventing*** the accumulation of carbon. Don't wait until your engine is choked and caked with it. Use **Johnson's Carbon Remover** every 500 miles, then the carbon is removed while it is soft and powdery, eliminating the frequent grinding of valves and ***keeping*** the motor ***always*** clean. No experience or labor required — you can easily do it yourself in ten minutes — and the cost is trifling.

JOHNSON'S CARBON REMOVER

Johnson's Carbon Remover is a perfectly harmless liquid to be poured or squirted into the cylinders. Millions of cans have been used with satisfaction. It simply softens the carbon, then the heat from the engine pulverizes it and it is blown out the exhaust. **Johnson's Carbon Remover** contains no acids and does not affect lubrication.

It is the easiest, cleanest, safest and most satisfactory remedy for carbon. It will save you from $3.00 to $5.00 over any other method without laying up your car. A dose of **Johnson's Carbon Remover**—the engine laxative—will stop that knock—quiet the motor, and give the maximum power with the minimum amount of fuel.

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This is the ideal repair for tubes, casings and rubber goods of all kinds. No time, labor or heat required. A Patch can be applied in three minutes and it's so simple a child can use it. Gives equally good results on a pin hole, puncture or on a large blowout.

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Black-Lac

Here is a preparation with which you can make your gray, dusty top and side curtains look like new. Johnson's Black-Lac is unequalled for blackening fenders, rims, hoods, lamps—and in fact, all worn metal parts. Prevents rust and keeps your car in a high state of repair.

JOHNSON'S
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will stop leaks immediately without laying up the car—no mechanical experience required. It is absolutely harmless in every respect. It isn't a make-shift—it's a permanent repair. It will ordinarily seal a leak in from two to ten minutes. A half pint is sufficient for a Ford.

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